FIRST SERIES No. 50 JUNE 1, 1921

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 1

THE PHYSICAL GROWTH OF CHILDREN FROM BIRTH TO MATURITY

BY

BIRD T. BALDWIN

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rates of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918

UNIVERSITY OF IOWA STUDIES IN CHILD WELFARE

PROFESSOR BIRD T. BALDWIN, PH. D., EDITOR

FROM THE IOWA CHILD WELFARE RESEARCH STATION

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BY

BIRD T. BALDWIN

Director and Research Professor
of Educational Psychology

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BULLETINS ON THE AIMS AND PROGRESS OF RESEARCH (IN CHILD WELFARE)

UNIVERSITY EXTENSION BULLETINS BY MEMBERS OF RESEARCH STATION STAFF

The Studies in Child Welfare are listed at moderate prices, but are sent free on request to persons who are actively engaged in child welfare work in the state. The Bulletins on the Aims and Progress of Research in Child Welfare may be obtained free of charge from the Librarian of the University. Extension Division Bulletins may be secured free of charge upon application to the University of Iowa Extension Division.

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PART I

CHAPTER I

INTRODUCTION

How do children grow physically? This *Study*, which aims to aid in the answer of this question, presents data and results of direct value in the formulation of standard norms in physical growth, with a view to establishing a basic science for allied investigations in mental, educational, social and moral development and clinical studies in nutrition.

In the foreword of the writer's previous *Monograph* in 1914 (27) it was stated:

> "The chief value of the *monograph* consists in the fact that it is the first attempt to follow consecutively the same groups of children through the elementary and high schools, either in physical growth or school standing, or the relation of the two. Since the curves and records represent individual histories, they will be of permanent value. The monograph also aims to give the present status of the problem of physical growth."

Since 1914 no similar reports in individual growth have appeared. This *Study*, which is limited to an intensive analysis of the problem of physical growth, is a sequel to the former *monograph* without in any sense being a duplication of material. The entire field of growth from birth to maturity is treated from the ontogenetic standpoint, with the coördinate subjects of anatomical and physiological ages. In the first eight chapters, or *Parts I-IV*, the context, tables, charts, and photographs are published here for the first time. The charts are based upon the writer's data. The Historical Orientation, the Comparative Tables and the Bibliography, *Parts IV-VI*, are completely reorganized elaborations of similar sections of the earlier publication, brought up to date.

Part I of this *Study* states the problem under consideration, discusses anthropometric instruments and methods, and outlines the anthropometric service of the Child Welfare Research Station, with some results from 5772 Iowa children. *Part II* gives as original data 5000 weight measurements on 400 infants; the height and weight of 9074 infants with comparative curves from

other investigations; the height and weight of 27,912 pre-school children; also 400 individual growth curves and 1548 total or partial coefficients of correlation. *Part III* presents an analysis of original data in the anatomical and physiological ages from 6500 boys and girls. *Part IV* includes an historical survey, in classified and chronological order, of 911 investigations in physical growth in this country and abroad. *Part V* summarizes in 643 comparative tables of measurements on infants, pre-school children, school children and adults under 30 years of age, data from all available authorities, comprising approximately 5,385,400 recorded cases in various countries. *Part VI* is an annotated bibliography in alphabetical order, of the 911 titles on the problem of the growth of infants, children and adults. *Part VII* furnishes in the form of a *Supplement* the English equivalents for the metric units of measurements, since all data, tables and charts in this *Study* are in the French system. A practical score card is also given in the English units of measure. The summaries, or conclusions, of the *Study* will be found at the end of each section or chapter, arranged in paragraph form. Supplementary data for the conclusions for *Part III* may be found in the original monograph (27). It has not been considered necessary to repeat the conclusions of the various chapters at the end of the book, since these conclusions can be much more conveniently and intelligently considered in connection with the data upon which they are based. In some instances the accumulated conclusions substantiate the same basic principles of growth from different points of view, but in no case is there direct duplication of the same conclusions. All conclusions are based on the writer's data.

The present task of collecting and interpreting original data and summarizing and evaluating other investigations, has been a long and exacting one, but the results will be worth the effort if other investigators are attracted to the field and former interested scientists will continue to make more intensive studies. *The results should form an international basis for scientific work in child development and welfare.* The writer's early interests in physical growth arose out of experimental work in child and educational psychology,—a field in which similar *Studies in Mental Growth* are being prepared for later publication.

The names of the interested persons who have assisted in securing data for the *Study* will be found distributed throughout the

context. The many good friends who have used or criticized the previous monograph have added much to the value of this *Study*. In particular Dr. Alês Hrdlička, curator of the Smithsonian Institution in Washington, D. C., helped directly in securing the anthropometric instruments and assisted in determining the methods and technique described in Chapter III. Dr. John Howland, chief of the Department of Pediatrics of the Johns Hopkins Hospital, made accessible to the writer the data used in Chapter IV and read the typewritten copy of this chapter of the manuscript on the Weight of Infants. Professor Karl Pearson, Director of the Francis Galton Laboratory in London read the chapter on correlations (VI), and made some significant suggestions, especially in regard to the desirability of including the coefficients of variation. Dr. Bundy Allen, Head of the Department of Roentgenology of the Medical College of the University, coöperated directly in taking the X-ray photographs used in Chapter VII.

The writer also has an added pleasure in acknowledging the valuable assistance and suggestions of Dr. Lorle I. Stecher, Research Associate in the Station who has contributed materially to Sections IV, V and VI, and who has read critically the manuscript and proof.

The names of the various schools which have furnished data will be found in the context of the *Study*. In addition to the University of Iowa Observational Schools and public schools in the state, special acknowledgement is made to Horace Mann School, Teachers College, Columbia University; University of Chicago Elementary and High Schools; Francis W. Parker School of Chicago; Baltimore Friends' School; and Friends' Select School, Washington, D. C.

CHAPTER II

ANTHROPOMETRIC INSTRUMENTS AND METHODS OF MEASURING

The international standardization of instruments and methods for taking measurements on living subjects is of paramount importance in the securing of comparable data for the science of physical growth. The Iowa Child Welfare Research Station has established through coöperation and collaboration with other scientific organizations and laboratories, standard instruments, accurate technique and uniformity of anthropometric methods within the fields limited to child development. Since the establishment of the Station there has been close coöperation with some of the leading anthropometrists in America, especially with the division of anthropology of the National Research Council, and the United States National Museum of the Smithsonian Institution, Washington, D. C. Dr. A. Hrdlička spent one week at the Station assisting in formulating methods of procedure for the anthropometric work. It has been through his coöperation that the compasses and calipers have been obtained. The other instruments have been made in the University shops, under the writer's direction. The aim has been to secure:

(1) Instruments with accurate units of measure in the metric system.

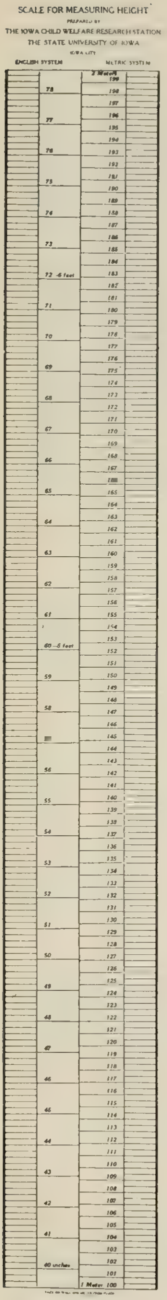
(2) Light, convenient, portable instruments of non-expandable material and simple design.

(3) Uniformity in standards of technique for measuring.

(4) The acceptance of definite land-marks for determining measurements.

1. Instruments

a. *The Paper Measuring Scale* (Photograph 1) This type of plane, which is a modification of the plane of Broca, was originally suggested by the Committee on Anthropology of the National Research Council; it has been modified by the writer and printed by a local printer. The plane consists of a strip of the best type



Photograph 1.

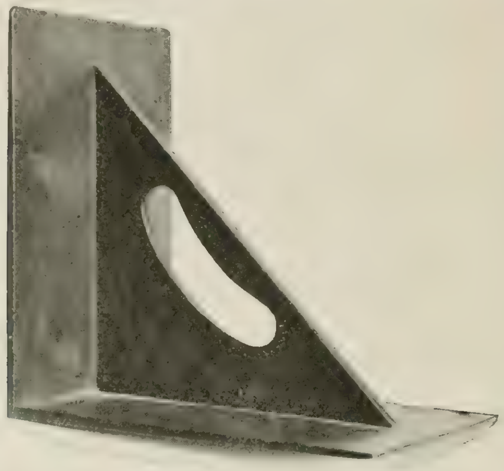
of inextensible and unshrinkable paper, one meter long and twelve and a half centimeters broad, with the metric divisions on the right edge of the scale in centimeters and millimeters, and the English on the left edge in feet, inches and fifths of an inch, and with a margin on each side of the scale and also at the top and bottom. An attempt was made to have a plate made from the scale as drawn by a draftsman, but this plan was abandoned, and the printed scale was substituted. Since the slugs used in printing are a little less than .5 mm. in thickness and the width of the line introduces a constant error, it was necessary to use strips of thin tissue paper between the separate slugs and to measure each millimeter distance accurately as a unit.

The paper plane has been used for several months and there has been no appreciable shrinkage under usual weather conditions. The chief advantages of the scale are that it is portable, may be sent through the mail, and is easily tacked or pasted to a wall or a specially prepared board. The position can be standardized, which is not possible with a rod.

The five millimeter unit has been used in place of the one millimeter, as the examiner soon becomes able to estimate the millimeters accurately, the reading is less fatiguing to the eyes and there is an added interest in the estimation of each particular case for measurement. The paper plane in the vertical position is used in measuring standing height and height sitting and in the horizontal position for the span of arms.

b. *The Square* (Photograph 2) The square consists of two pieces of seasoned walnut 18 cm. by 13 cm., joined at right angles. On the inside of the median line is a narrow strip 5 mm. thick, in which is cut an opening that serves as a handle. The square which is used for the three measurements just stated above was constructed in the University Shops.

c. *The Bench.* The bench, also constructed in the University Shops, is used for height sitting. It is made of thoroughly seasoned walnut. Two sizes have been adopted, one 30 cm. in height by 30



Photograph 2. Square

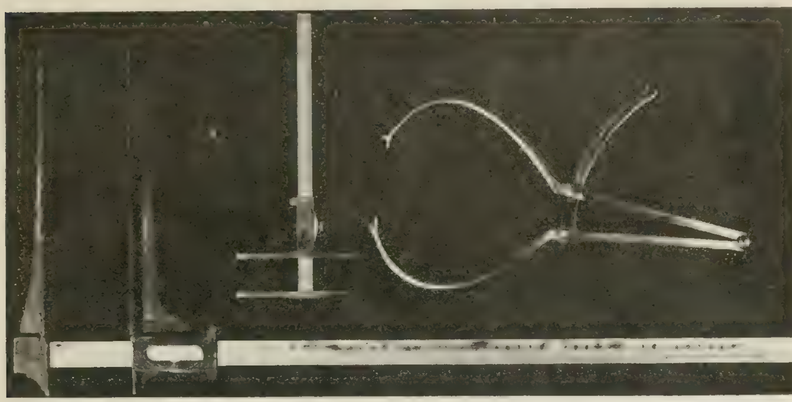
cm. square, the other 40 cm. in height by 40 cm. square. For adults, it is recommended that a third size, 50 cm. square be used.

d. *Large Sliding Calipers* (Photograph 3) The large sliding caliper is the Hrdlička compass made in Washington for the Research Station and tested by the Bureau of Standards. This compass has also been made by Collin in Paris. The caliper consists of a hollow rod, 70 cm. long, 2.2 cm. broad and 0.8 cm. thick, made of well nickeled and welded brass strips; and of aluminum branches, 26 cm. long (in the free) and 3.5 cm. broad. It is light, very serviceable, durable, easy-working, and accurate.

e. *Small Sliding Calipers* (Photograph 3) The sliding caliper (compas glissière) was made in Washington and tested by the Bureau of Standards. This is the Collin compass and is accurately and well designed.

f. *Spreading Calipers* (Photograph 3) The calipers in use are the Hrdlička type, made by Dr. Ballauf, Washington, first made by Collin in 1912. The terminal parts are in a straight line at the spread of 10 cm. There is a guard on the lower portion of each branch 8 mm. from the point, to regulate the distance of introduction into the meatus. The resulting instrument is but imperceptibly

heavier than the older standard compass of Mathieu; it serves with equal facility the same purposes.



Photograph 3. Three Types of Calipers

g. *Tapes.* On account of the delay in receiving linen tapes from Paris, the ordinary millimeter steel tape is used. It has several disadvantages, a linen tape of non-elastic material being preferable.

h. *Scales.* The scale in use in the anthropometric laboratory is the Buffalo type with pillar 3′ 3″ high, on wheels, beam being triple bar. On one side:

Top bar is marked 100 (50 kilo graduation)
Middle bar is marked 50 (5 kilo graduation)
Lower bar is marked 5 (1/20 kilo graduation)

On other side:

Top bar is marked 200 (100 pound graduation)
Middle bar is marked 100 (10 pound graduation)
Lower bar is marked 10 (1/10 pound graduation)

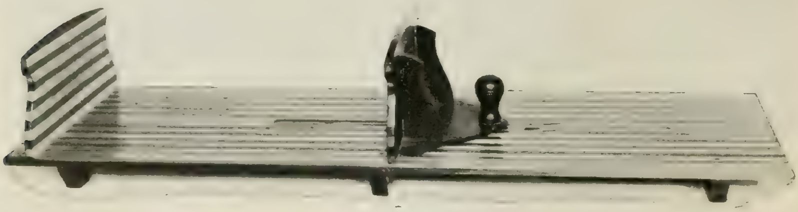
This scale is accurate, portable from room to room but heavy for transportation.

i. *Dynamometer.* So far the Smedley hand dynamometer sold by Stoelting has been used, but the Collin instrument will be substituted as soon as it is received from abroad. The "Martin Method" which uses the spring balance scales is also being tested out.

j. *Wet Spirometer.* No spring spirometer has been found to be accurate. The Stoelting model is used. This apparatus is too familiar to warrant description here.

k. *Measuring Board for Infants* (Photograph 4). The accom-

panying photograph shows a new measuring scale for determining the reclining length and reclining sitting height of infants. It was designed by the writer and made in the manual training shop of the University. The scale is one meter in length, with an additional margin of 4.5 centimeters at the one end. The width is 20.5 centimeters, with standardized buttonwood millimeter scales on either side. The vertical plane for the head rest is 15 centimeters at its greatest height, and the sliding vertical plane is attached to a brass rod which moves freely in a brass groove in such a manner that the millimeter reading may be taken from either side. The



Photograph 4. Measuring Board for Infants

board is made of inlaid walnut and buttonwood and the standards on which it rests when in contact with the table, are covered with heavy felt. The scale is accurate and portable.

2. Measurements Taken

For purposes of determining the physical development of children from birth to maturity the following list of measurements has been selected for use in the anthropometric department of the Research Laboratory.

A. LENGTH.

1. *Standing*
2. *Sitting*
3. *Span of arms*
4. *Upper arms (shoulder-elbow)*
5. *Forearm (elbow-finger tip)*
6. *Lower leg*
7. *Face*

B. WIDTH.

8. *Shoulder*
9. *Hips*

10. *Face*

C. DIAMETER.

11. *Head (anterior-posterior)*
12. *Head (transverse)*
13. *Head (height)*
14. *Chest (width)*
15. *Chest (depth)*

D. CIRCUMFERENCE

16. *Head*
17. *Chest*

E. WEIGHT

18. *Body weight*

F. BREATHING CAPACITY

19. *Lung capacity minus residual air*

G. STRENGTH

20. *Strength of right forearm*
21. *Strength of left forearm*
22. *Strength of wrist-right and left*
23. *Strength of elbow-right and left*

H. INDICES

24. *Sitting-standing*
25. *Cephalic-index*
26. *Chest-index*
27. *Vital-index*
28. *Weight-index*

I. CRANIAL CAPACITY

3. Methods

A. LENGTH

(1) *Standing Height.* This measurement is made with the *Research Station Paper Measuring Scale* previously described, and the wooden *square.* The subject stands straight with heels together, and heels, buttock, upper part of back (and generally the head) against the wall to which the scale is attached. The arms are extended at the side in a natural position and the head is in such a position that the visual and biauricular axes are horizontal. The *square* may be held in either hand. If held in the left hand the readings are taken from the right margin of the plane and if held in the right hand, from the left margin of the plane. The *square* is

Photograph 5. Method of Measuring Standing Height

brought down firmly two or three times in succession on the top of the head, with sufficient force to feel the impact of the skull, and the reading taken from the last position.

(2) *Sitting Height.* For the measurements of the sitting height, the Geneva agreement has been followed which recommends: "The subject sits on a horizontal and resisting seat (bench) about 30 to 40 cm. high (this height being proportionate to the stature of the subject): the knees are flexed; the dorsal aspect of the trunk is to make contact with the vertical plane or with the anthropometric rod or plane at two points viz., at the sacral region and again between or at the shoulder blades. The axis of vision is horizontal. The height of the vertex above the surface of the seat is to be measured." (406 p. 64.)

(3) *Span of Arms.* This measurement is the distance from the tip of the middle finger (medius) of the left hand to the tip of the middle finger (medius) of the right hand with maximum extension of the arms when the subject is standing in a normal position, similar to the position required for stand-

ing height, against a plane background. The child's left middle finger touches a vertical wall or moulding and the right extends over the *paper plane* placed in a horizontal position at a level with the child's shoulders with the fingers rigid. The two arms are extended and after the right arm (free arm) has been raised in a line with the left the observer applies the *square* lightly against the

Photograph 6. Method of Measuring Length of Forearm

free end of the middle finger of left hand and reads the greatest distance recorded, noting that both fingers are simultaneously in contact with the terminal limits.

(4) *Upper Arms.* The *large sliding calipers* are used. The

elbow is flexed and the terminal points are the acromion at the shoulder and the external condyle of the humerus at the elbow.

(5) *Forearms.* The *large sliding calipers* are used to find the distance from the olecranon process of the elbow to the finger tip, with the elbow flexed at right angles in front of the subject and with palmar side up. This measurement varies with the two arms and the position of the arm. It is being standardized by Mr. Howard R. Mayberry of the Station. (Photograph 6)

(6) *Lower Leg.* This measurement is from the knee to the sole of the foot when the knee is flexed at right angles. The measurement is made with the *large sliding calipers.*

(7) *Face.* The length of the face is taken with the *spreading calipers* from the nasion (the mid-point of the naso-frontal suture) to the lowest point of the chin.

B. WIDTH

(8) *Shoulders.* The *large sliding calipers* are used for finding the distance between the two great prominent tuberosities of the humerus bones below the acromion processes. The arms hang down at the subject's side and the pressure of the calipers is increased until the resistance of the bone is appreciably felt.

(9) *Hips.* The width of hips is measured in a similar manner to that of the shoulders with the *large sliding calipers*, using the widest part over the trochanters for the two terminal points.

(10) *Face.* The width of the face is taken with the *spreading calipers* at the greatest bizygomatic distance.

C. DIAMETER

The methods adopted here are those of Hrdlička (406)

(11) *Head* (*anterior-posterior*)

"The maximum glabello-occipital diameter of the vault."

Instrument: The spreading compass or calipers (compas d'êpaisseur, Broca or Hrdlička).

"Landmarks: Anteriorly—the most prominent point of the glabella; posteriorly—the most prominent point of the occiput as shown by the maximum determinable spread of the branches of the compass (Intern. Agr.)

"Method: According to older methods (see Bertillon, Martin), the end part of each branch of the instrument was held in one hand, as in measuring the face. For measurement of the head this is somewhat clumsy. A better method is to hold the compass so that its butt (or joint) rests on the hypothenar eminence of the hand, the two proximal parts of the branches reposing respectively on the ball of the medius and on the second joint of the forefinger, while the thumb holds the instrument to the

hand. The observer applies the thumb and middle finger of his left hand, in contact, to just below the glabella, places the free end of the left branch of the compass on these fingers so that the point touches the glabella, and applies the left forefinger over the end. This gives a ball-and-socket arrangement which enables the measurer to hold the point of the left branch of his compass steadily over the glabella without fear of displacement. This branch of the instrument needs no further attention. The right hand is now moved around the proximal part of the compass, so that the two branches rest on the ball of the fourth and on the second joint of the middle finger and are held and controlled by the ball of the thumb and the ball of the forefinger. This hold permits not only an easy handling of the instrument with perfect control, but affords also a great

Photograph 7. Method of Measuring Length of Head

facility for regulating the pressure. The free end of the right branch is then applied over and somewhat to one side of the median line of the most prominent part of the occiput, and is moved up and down in saw-tooth fashion from side to side of the occiput until the maximum length is encountered. The eyes watch only the scale. The ease of manipulating the instrument when handled in this manner is very gratifying". (Photograph 7).

(12) *Head* (*transverse*)

"The greatest transverse diameter in horizontal plane which can be found on the vault by the spreading compass (compas d'êpaisseur, Broca or Hrdlička).

"Landmarks: Determined solely by the maximum breadth of the skull above the supra-mastoid and zygomatic crests (Intern. Agr.).

"Method: The instrument is held as in first position for measuring the length, and this position is retained. The left hand is placed lightly on the top of the head of the subject, assisting in bringing the latter into the convenient position for taking the measurement; the instrument is applied horizontally somewhat above what appears to be the maximum breadth,

Photograph 8. Method of Measuring Breadth of Head

and is moved in a zigzag way antero-posteriorly, descending and again ascending by zigzags, until the maximum breadth is found. The eyes watch only the scale. It is necessary to repeat the movements in an ascending and possibly once more in a descending direction, until the observer is positive that the maximum breadth has been ascertained". (Photograph 8).

(13) *Head (height)*[1]

"The height from the middle of the line connecting the floor of the auditory canals to bregma".

Instrument: The spreading compass of Hrdlička (Photograph 3).

The methods adopted here are those of Hrdlička (406).

"Method: The instrument is held by the right hand just below the joint. The head of the subject being steadied by the left hand, one branch of the instrument is gently introduced into the left ear as far as the guard

1. The Monaco Agreement stipulates that the height of the head be taken from "the superior border of the auditory opening" to the "vertex;" but no satisfactory method for taking the measurement is offered or has ever been devised. The method here described has been practiced by the author since 1898 and found quite effective.

permits, and the same is followed with the right ear. The compass is then slightly raised to assure penetration as far as the guards allow, is taken hold of a short distance above the scale by the left hand, allowed to sag down by its own weight and held in position. The ulnar side of the hand that holds the compass should for greater steadiness repose on the head of the subject behind the instrument. The scale of the compass is now brought as near as possible over the bregma, the spread of the branches of the compass is noted on the scale, the distance from bregma to lowest part of the scale is carefully ascertained by the rod of the sliding compass, and the operation is completed. All that is now necessary is to read off on a previously prepared scale the total height from the

Photograph 9. Method of Measuring Height of Head

base line of the points of the compass to the lowest part of the scale of the same at the spread observed in the subject at hand, and to deduct from this the distance between the bregma and the scale. Special care

must be exercised that neither of the branches, particularly that in the right ear, slips out of the meatus. (Photograph 9).

"This method is readily learned and causes the minimum of inconvenience to the subject (particularly if the points of the instruments are warmed in water or by the breath of the observer before introduction), and with due care it gives results which vary within less than 3 mm. The time required is scarcely more than the average time for ascertaining the head length. The external portions of the floor of the meatus, while not as perfect landmarks as could be desired, give with this method and instrument, in the writer's experience, results that are more satisfactory than those obtained by any other method or instrument so far devised for taking this important measurement of the head. The preference of bregma to the vertex for the superior 'point de repère', is in accordance with the Geneva Agreement, which stipulates two heights of the vault and both to the bregma."

(14) *Chest* (*width*)

The methods adopted here are those of Hrdlička (406).

"Transverse diameter: Subject stands in natural, easy, erect position. The forearms are flexed at about right angles, and the arms are lifted forward and upward to about 30 degrees from the body. They are directed to be held limp without any tension, and the examiner satisfies himself that there is no tension by lightly taking hold of the forearms and moving the arms slightly up and down. The object of the position is on the one hand to relax all the thoracic muscles, and on the other to permit the application of the instrument. The same position in every respect is preserved for the antero-posterior diameter.

"The *large compass* is now applied to the chest in such a way that its rod lies directly over the nipples (or corresponding line in women), the fixed branch is pressed against the thorax until it meets with the resistance of the ribs, and the right branch is applied repeatedly to the opposite side of the thorax, with equal pressure, during inspiration and expiration until the medium between the two can be arrived at. It is the medium which is recorded. The instrument is held so that its plane is at right angles to the vertical plane of axis of the thorax.

(15) *Chest* (*depth*)

The antero-posterior diameter is taken so that the fixed branch of the compass is applied to the nipple line, the rod of the instrument to the ribs on the left side, and the movable branch to the posterior part of the thorax, the instrument being held again at right angle to the vertical axis of the chest. Here also we take repeated measurements until the medium between normal inspiration and expiration is ascertained, and this is recorded."

D. CIRCUMFERENCE

(16) *Head.* The circumference of the head is taken at the greatest distance over the frontal and occipital processes, the tension of the tape being regulated by practice or by the observation of the spring indicator on the tape.

(17) *Chest.* The circumference of the chest is taken, with or without clothing, at the nipple line for boys and at a corresponding height for girls.

E. WEIGHT

(18) *Body Weight.* The weight is taken with or without clothing. When clothing is included, the shoes and coats are removed. Clothing for children below 12 years of age weighs on an average .75 kgs. and for children over 12 years of age on an average 1.1 kgs.

F. BREATHING CAPACITY

(19) *Lung Capacity Minus Residual Air.* The measurement has been taken in the usual manner, with conditions standardized as far as possible, using the wet spirometer, which gives the volume of lung capacity minus the residual air. Mr. A. W. L. Bray, who began his work at the Station on January 1st, 1921, as a Research Associate in Child Welfare, will aim to standardize new instruments and technique. Waldenburg's pneumatometer is being tested out and various other methods of measuring respiratory capacity.

G. STRENGTH

(20-23) Here again the generally used methods for the hand dynamometers have been used. The writer has found the "Martin Method" (Walter Reed General Hospital Monograph I, Washington, D. C., pp. 11 ff.) a promising one, and the Kellogg method used at Battle Creek is also being tried out.

H. INDICES

(24-28) (For a theoretical discussion of indices of growth, see Chapter VI. The *sitting-standing index* is determined by dividing the sitting height by the standing height; the *cephalic index* by finding the ratio of the width of the head to the length; the *chest index* by dividing the depth of the chest by the width; the *vital index* by dividing the breathing capacity by the height; the *weight-height index* by dividing the weight in kilograms by the height in centimeters or by the square or cube of the height.

I. CRANIAL CAPACITY

For the present the Lee and Pearson (468) formula No. 14 is being used. It is

Male. Brain cc.=.000337 (L—11mm.) (B—11 mm.) (H—11 mm.)+406.01.

Female. Brain cc.=.0004 (L—11 mm.) (B—11 mm.) (H—11 mm.)+ 206.6.

4. Health Studies From Iowa Cities

Many communities in Iowa have been stimulated to undertake, in collaboration with the writer, systematic measurements of their school children. The following short studies are included as examples of the Anthropometric Service of the Station.

In coöperation with Superintendent Frank L. Smart of Davenport and Superintendents Z. C. Thornburg and J. W. Studebaker of Des Moines, Iowa, careful physical measurements have been made for two years by the writer and his graduate assistant, Mr. Mayberry, on eighteen physical traits of 1250 children between five and sixteen years of age. The following table gives the mean measurements and indices for 563 children for ten traits for the ages from five to thirteen years, inclusive, for the combined schools, which represent three of the best grammar schools in the state from the standpoint of equipment and the social status of the children.

Comparing the mean measurements of the elementary and grammar school pupils of Davenport and Des Moines (Tables I and II) with the norms in Chapter VI, it will be noted that the boys and girls are shorter and lighter for all ages. In sitting height, the boys are slightly above the norm for ten years and the girls and boys for ten and eleven years. In chest girth, the boys and girls are slightly superior to the norm, probably due to the fact that this measurement includes the thickness of clothing.

In 1917 Mr. F. F. Vasey, who was then superintendent of schools in Charles City, measured 192 boys between 10 and 15½ years of age. Mr. Vasey subsequently became superintendent in Mason City and made there in 1919 a similar study of 139 boys from 13 to 17 years of age.

An analysis of the data from these two studies shows that the Charles City boys are below those in Mason City in stature, from 13 to 16 years of age. In weight they are not only lighter but proportionately lighter for their weight as shown by the weight-height indices. In breathing capacity the Charles City boys are superior; this is particularly marked in proportion to their weight.

From 13 to 14 years of age, the Mason City boys average approximately the same as the "*proposed norms*" for weight, height, and breathing capacity given in Chapter VI of this *Study*. From 14 to 16 years of age, the Mason City boys are slightly above the average in weight, height, and breathing capacity; from 16 to 17

TABLE I. MEAN MEASUREMENTS

ELEMENTARY AND GRAMMAR SCHOOL PUPILS, DAVENPORT AND DES MOINES, IOWA

299 Boys—264 Girls.

Ages / Traits		5	6	7	8	9	10	11	12	13
Height	Boys	109.9	111.8	119.3	125.9	128.7	133.3	141.0	142.4	147.0
	Girls	107.3	111.0	117.5	121.2	127.9	133.1	139.4	143.7	150.7
Weight	Boys	21.1	19.4	22.0	24.5	26.5	27.0	33.2	34.1	36.8
	Girls	17.2	17.8	20.9	21.6	24.9	27.8	30.3	35.0	37.1
Sitting-height	Boys	61.9	62.3	65.4	67.9	68.7	71.6	74.2	75.6	76.5
	Girls	59.4	61.2	64.5	65.8	69.3	69.9	73.8	75.5	78.7
Span of arms	Boys	107.1	109.2	115.0	121.6	126.4	132.1	139.2	141.7	146.4
	Girls	101.0	105.5	111.7	117.1	122.9	129.2	137.3	141.1	150.2
Chest width	Boys	19.8	19.1	20.1	20.6	21.0	21.5	22.7	22.4	23.1
	Girls	18.4	18.6	19.5	19.5	20.3	21.1	21.8	22.4	22.9
Chest depth	Boys	14.9	14.7	15.4	15.8	15.9	16.1	16.8	16.7	17.8
	Girls	14.2	14.2	14.8	14.8	15.4	15.7	16.3	17.1	17.9
Chest circumference	Boys	61.5	59.6	59.9	61.9	64.0	65.8	70.0	69.1	73.3
	Girls	57.9	59.4	59.6	60.7	61.8	65.4	68.4	73.6	75.8
Head (a) Length	Boys	17.9	17.8	17.8	18.0	18.0	18.2	18.2	18.1	18.5
	Girls	17.4	17.0	17.4	17.6	17.5	17.7	17.8	17.9	18.1
Head (b) Width	Boys	14.2	14.1	14.3	14.5	14.4	14.5	14.5	14.6	14.8
	Girls	13.6	13.8	13.9	14.2	14.1	14.2	14.2	14.2	14.6
Head circumference	Boys	52.4	51.9	51.3	51.5	52.1	52.5	53.5	53.1	53.9
	Girls	49.6	50.1	50.2	50.9	51.3	52.2	52.7	52.7	54.3

TABLE II. MEAN INDICES

ELEMENTARY AND GRAMMAR SCHOOL PUPILS—DAVENPORT AND DES MOINES, IOWA.

Ages		5	6	7	8	9	10	11	12	13
Traits										
Weight-height index	Boys	.191 (1.07)*	.173 (.97)	.184 (1.03)	.194 (1.08)	.198 (1.11)	.202 (1.13)	.235 (1.31)	.259 (1.45)	.253 (1.41)
	Girls	.162 (.91)*	.163 (.91)	.178 (.99)	.178 (.99)	.194 (1.08)	.208 (1.16)	.217 (1.21)	.243 (1.36)	.246 (1.37)
Sitting-standing index	Boys	.559	.557	.547	.539	.534	.536	.526	.531	.520
	Girls	.553	.561	.548	.542	.541	.527	.529	.525	.522
Chest index	Boys	.751	.767	.766	.764	.753	.751	.742	.746	.770
	Girls	.773	.762	.761	.761	.758	.744	.748	.762	.783
Cephalic index	Boys	.793	.792	.803	.806	.800	.797	.797	.807	.800
	Girls	.782	.817	.799	.807	.806	.802	.798	.793	.807

* English system.

they are below the average with a wide range of individual differences throughout the group. For example, the largest boy in the 14 year group weighs 65 pounds more than the smallest boy of the same group. The largest boy in the 16 year old group weighs 77 pounds more than the smallest boy of that group. In the 14 year old group the tallest boy is 13.1 inches taller than the shortest boy of that group. In the 14.5 year old group, the tallest boy is 12.3 inches taller than the shortest of the group. In the 14 year group, the boy with the best breathing capacity exceeds the boy with the poorest breathing capacity by 90 cubic inches. In the 16 year group, the boy with the best breathing capacity has 185 cubic inches greater capacity than the poorest boy of the group.

Through the work of Mr. I. J. Price at Mason City, preliminary data concerning the Grammar School boys have been collected up to October, 1919. His analysis of these data may be summarized as follows: The ratio between weight and height and between breathing capacity and height was determined for each pupil. The variations in these ratios is more significant than a variation in any of the single items such as weight, or height, or lung power. A boy may be under "normal weight" and under "normal height" for his age and still have a good ratio. He may be above standard in height at any specific age, and have insufficient lung capacity for his other physical traits. The ratio is a good indicator of the boy's potential health situation.

The distribution of the weight-height indices indicates that as many as 17 per cent of the boys in grammar school are below normal ratios, suggesting poor health.

The vital-height indices of 211 boys of the grammar school show that on an average 55 percent of boys are lower in height and breathing capacity index than is normal.

In Mason City 3000 children are being measured monthly and in a few years consecutive measurements will be available showing the effects of remedial physical training and inspection.

In New Providence, Hudson, Calmar, North Liberty, and in the University Elementary and High Schools of Iowa City, the height and weight and other measurements of the boys and girls approximate the norms in Chapter VI, but the wide range of ages from five to 19 years makes the number for half year periods too few for adequate comparison at this stage of the work.

Through the coöperation of A. L. Urick, the Commissioner of

the Bureau of Labor Statistics of Iowa, the physical measurements on 4727 boys and 2577 girls granted working certificates in the state from July 1, 1918 to July 1, 1920, are given below (Table III) and compared with the writer's norms for 14, 14½, 15 and 15½ years of age.

It will be noted that these boys and girls measure in height up to the standards or above, except at 15 and 15½ years of age; in weight they exceed the norms except at 15 and 15½, when they are below. The norms, however, are for nude children and these children wore clothing and shoes.

TABLE III

MEASUREMENTS OF CHILDREN GRANTED WORKING CERTIFICATES

Age	No. of cases	Average Height	Average Weight	Height-Weight Index
14-14½	Boys 1192	156.26	47.46	.297 (1.66)*
	Norm	154.94	43.05	.279 (1.56)
	Girls 532	157.66	47.73	.303 (1.69)
	Norm	155.70	46.40	.299 (1.67)
14½-15	Boys 1274	159.59	47.18	.290 (1.62)
	Norm	157.99	44.88	.285 (1.59)
	Girls 691	158.62	48.85	.306 (1.71)
	Norm	158.75	47.99	.303 (1.69)
15-15½	Boys 1228	159.66	45.50	.286 (1.60)
	Norm	161.80	47.57	.295 (1.65)
	Girls 674	159.21	49.89	.313 (1.75)
	Norm	159.00	50.02	.315 (1.76)
15½-16	Boys 1033	160.43	49.16	.311 (1.74)
	Norm	166.35	52.56	.319 (1.78)
	Girls 680	159.79	50.95	.310 (1.73)
	Norm	160.78	52.29	.326 (1.82)

* English system.

5. SUMMARY

(1) The international standardization of instruments and methods for taking measurements on living subjects is of paramount importance in the securing of comparable data for a science of physical growth.

(2) The instruments described in this chapter are light, portable and accurately constructed of non-expandable material, graduated in the metric system, which should be universally used for scientific work.

(3) The methods of procedure and technique are universal standards as far as possible at this stage of the work, with definite landmarks indicated.

(4) Twenty-three measurements are selected and described for an international basis for anthropometric work in child welfare.

(5) An anthropometric service laboratory has been organized for physical measurements and their evaluation on infants and children of so-called normal and superior development, the aim being to secure normal standards for American children.

(6) The comparative type studies from Iowa show these children to be on the average slightly below the normal standards which are given in the subsequent chapters.

(7) These studies in individual growth furnish a basis for clinical studies in nutrition and physical development.*

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* The University of Iowa, through its Child Welfare Research Station and Extension Division has formulated a coöperative plan to assist school officers and parents in the State in recording and evaluating the semi-annual physical measurements of the growth of their boys and girls, between the ages of 5½ and 18 years. These measurements which are few and simple, offer the best indices of growth, health and nutrition. The measurements are to be taken in the school by the medical inspector or the teacher of mathematics or science who should be especially accurate. The cards are forwarded in June to the Extension Division and the Research Station records the results, compares them with standards for Iowa children and returns the cards and tabulated results with critical comments through the Extension Division.

The essential principle of the plan lies in the coöperation between the University specialists and the school or parents, affording continuous observations on the same children for periods from one to twelve years. In no homes or schools in the United States have an appreciable number of children been measured consecutively. Iowa is the first state to organize as one phase of its child welfare work, a standardized method for repeated measurements on the same boys and girls for long periods of time, resulting in *individual history* curves of scientific value. An extension of the plan will be issued subsequently, to include a similar method for the measurement of infants from birth to six years of age.

Arrangements can be made by the larger school systems of the state to have a limited number of the staff trained by the Research Station at the University or through the institutes, in accurate methods of making and recording data on the measurements to be taken.

The individual growth cards of the child whose measurements are recorded, follow one child from grade to grade in school, or from one portion of the state to another, if a change of locality becomes necessary. No expense is involved except for the cost of the individual record card, which may be used for twelve years, and the postage on the part of the school or parent that sends the cards to the University. For details of this work see Extension Bulletin No. 59.

PART II

CHAPTER III

THE GROWTH OF INFANTS

That children grow more in proportion to their initial size at birth during the first year than at any subsequent period is generally recognized. It is also known that the number of cells in the human species tends to become fixed after two or three years, (215) and from that time on growth is a condition of cell enlargement. Beyond some general information as to growth in weight and length, there is little knowledge of just how small children grow. While several physicians have published growth charts of infants, all with the exception of a few weight norms are based on single measurements of different individuals and the average of such measurements gives little real insight into the characteristic trend of individual growth curves. Realizing the great need for individual growth curves from birth to seven years of age, the Research Station has started such measurements.

It is not only difficult to measure babies accurately, but it is also

Photograph 10. Preparing to Measure a Baby

a problem to know what measurements to make, what are most significant. These should be selected always with the ultimate purpose in view. After preliminary trials and after consulting the litera-

ture in search for the measurements that are most needed and can be taken most accurately, the writer has decided to measure the first 18 traits given on pages 18 and 19. The length of the arm and of the leg is difficult to obtain accurately on account of localizing the acromion ad trochanter points. The chest circumference is necessarily approximate, since the texture of the body and the tautness of the tape vary from time to time. The position of the child is difficult to standardize and the reclining length is longer than the standing length. In most instances it is necessary to adapt

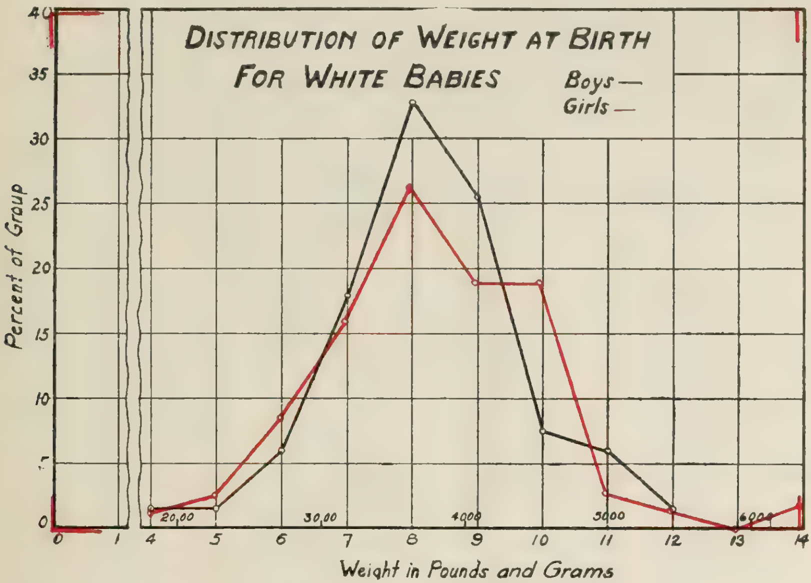


Chart 1

the instruments for measuring infants, since the skin is so sensitive to pressure and cold. The height of the head is a particularly difficult measurement to make on an infant and should not be undertaken except with great caution.

I. HOW INFANTS GROW IN WEIGHT

1. Data and Method of Study

a. *Source of Data.* After searching through several Departments of Pediatrics in the hospitals of this country for good consecutive records, the writer found, prior to his coming to Iowa, a group of

approximately 5000 babies that had been weighed at frequent intervals at the Baby Milk Fund Association of Baltimore, by physicians under the direction of Dr. Mason Knox, Jr., from the Johns Hopkins Hospital Clinic, of which Dr. John Howland is chief. From this group were selected all who had been weighed at least monthly during the first year; of these many were measured weekly. Two hundred of each race and one hundred of each sex were selected on the basis of the frequency of the number of measurements and the amount of supplementary data in regard to diet, diseases, nationality, and other recorded facts. The results gave approximately 5000 weight measurements, and the individual growth curves offer a basis for more detailed scientific study in connection with work at the Research Station where a number of normal babies in the

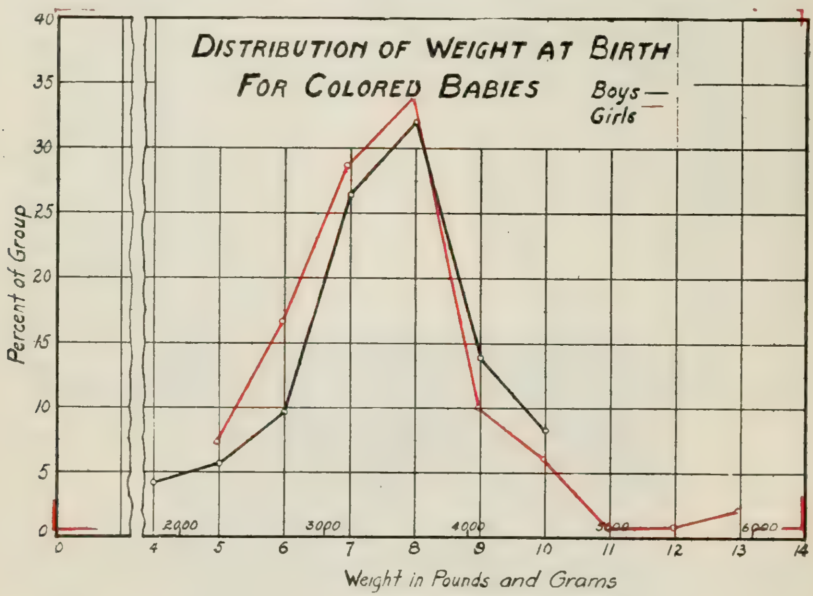


Chart II

homes of Iowa City and in the University Hospital are now being measured.

b. *Distribution of Weight at Birth.* Charts I and II, pages 35 and 36 show the distribution of weight at birth of the white and colored babies, boys and girls. It will be noted that the mode for each of the four groups is 3629 grams. The average for the white boys is 85 grams less than for the white girls. The colored boys are slightly

heavier than the colored girls, who are 364 grams lighter than the white girls on the average. The range of distribution, it will be noted, is from 1814 to 5443 grams for the white boys and from 1814 to 6350 grams for the white girls; for the colored boys the distribution is from 1814 to 4536 grams, for the colored girls from 2268 to 5897 grams.

2. White Female Babies

a. *Effects of Artificial Feeding.* The white female babies show, on the average, a steady increment of growth during 23 weeks when there is no appreciable gain for several weeks. There is also a

Table IV

MEAN WEIGHT AND MEAN DEVIATION OF 100 FEMALES—WHITE

Number of Cases	Age in Weeks	Grams	
		Weight	Mean Deviation
67	Birth	3714	559
9	1	3317	454
27	2-3	3770	491
37	4-5	4082	403
38	6-7	4111	479
44	8-9	4451	680
59	10-11	4763	632
51	12-13	4904	658
71	14-15	5245	777
57	16-17	5471	703
56	18-19	5755	870
45	20-21	5982	961
58	22-23	6265	870
58	24-25	6265	1004
55	26-27	6520	1021
51	28-29	6747	930
59	30-31	7059	947
49	32-33	7258	919
53	34-35	7172	794
45	36-37	7484	743
47	38-39	7683	808
42	40-41	7938	836
40	42-43	8023	921
33	44-45	8335	879
32	46-47	8335	802
30	48-49	8647	876
26	50-51	8788	961
35	52-53	8902	876
29	54-55	8930	1058
15	56-57	9015	794
1303			

diminution in the increment of growth for the 53 weeks. The artificially fed babies of this group, who, like the others, are at this period under the supervision of the physicians in charge, grow less rapidly just after birth, but tend to reach the normal weight toward the end of the first year. At the twentieth week, all but four out of 15 weighed at least 907 grams less than the average weight for that week; and at the end of the year, seven out of 10 weighed within 454 grams of the average or more. It is fairly certain that these artificially fed babies do not recover so quickly from the diseases which beset them as do the breast fed babies. A single attack of bronchitis or diarrhea may retard the normal growth for a month or more, while many of the apparently healthy breast fed babies will lose no weight at all unless complications arise.

b. *Effects of Disease.* The acuteness and duration of the disease, the nursing, the medical care and home conditions, together with the native vitality of the babies, no doubt have much to do with the manner in which the diseases affect growth and health, but some supplementary facts may be gleaned by including the disease histories recorded. For white girl babies, whooping cough and pneumonia apparently are serious in their effect on growth; recovery is slow and several months elapse before the child shows normal increase in weight. Constipation, intestinal indigestion and vomiting are usually accompanied by a slight loss in weight, but recovery is ordinarily rapid. When diarrhea occurs at the same time, it may be several weeks before normal growth is resumed. Diarrhea alone does not seem to have much effect on the weight of the otherwise healthy child. So also with the other diseases; if they occur singly the child usually maintains its normal growth, though it will seldom exceed it; when a child has two or more diseases, as is frequently the case, the weight is apt to fall below the average. These facts are given as supplementary data, and no direct conclusions can be drawn from them.

3. White Male Babies

The average weight for the white boy babies at birth is 85 grams less than for the white girls, but the gain at first is more rapid, so that in the six to seven weeks period the boys are about 368 grams heavier than the girls. From that period to the end of the first year, their weights increase with equal rapidity, the average for the boys being, however, 454 grams ahead of the girls.

TABLE V

MEAN WEIGHT AND MEAN DEVIATION OF 100 MALES—WHITE

Number of Cases	Age in Weeks	Grams	
		Weight	Mean Deviation
71	Birth	3629	490
5	1	3827	417
37	2-3	3799	448
41	4-5	3969	493
47	6-7	4479	536
63	8-9	4848	544
69	10-11	5075	553
67	12-13	5358	627
61	14-15	5642	683
64	16-17	6038	822
44	18-19	6294	683
65	20-21	6407	751
66	22-23	6691	765
48	24-25	6776	958
57	26-27	7059	754
49	28-29	7172	800
45	30-31	7626	890
45	32-33	7541	788
43	34-35	7853	904
28	36-37	7966	819
40	38-39	8250	709
32	40-41	8477	836
24	42-43	8760	697
29	44-45	8732	573
29	46-47	8788	539
24	48-49	8817	953
21	50-51	9270	683
24	52-53	9299	930
20	54-55	9214	451
21	56-57	9440	649
15	58-59	10121	689
1294			

a. *Effects of Artificial Feeding.* Artificial feeding for this group apparently shows less effect on the boys than on the girls. Only six out of 15 weigh 907 grams less than the average at 20 weeks and at the end of the year all but two out of 13 are within 454 grams of the average. Also very few illnesses are recorded for these 15 babies. There is one case of whooping cought and one of pneumonia, and in both cases loss of weight is slight and recovery rapid. There is, therefore, some indication that even at this early period these boys are more robust than the girls.

b. *Effects of Disease.* The number of illnesses recorded for the white baby boys is less than two-thirds of the number recorded for white girls. The general effect of the different diseases on growth is apparently about the same as in the case of the girls. Such diseases as pneumonia, whooping cough, mumps, and measles may stop growth as indicated by weight for a month or two, but if the child is strong, recovery is very rapid.

The growth of these infants shows the same relationship to diet that was found in the case of the girls. Providing the mother has sufficient milk, the child's weight increases consistently for six or seven months. In most cases the boys have been given supplementary food, such as cow's milk, zwieback, cereals, and broth sometime between the sixth and ninth months, and in only a few cases has additional food been withheld until the eleventh month. Consequently, there are not so many cases which show the tendency for the growth to diminish during the ninth and tenth months as were found in the case of the girls who were entirely breast fed until the eleventh month.

4. Colored Female Babies

The average weight for colored girl babies at birth is 3340 grams, which is 68 grams lighter than for colored boy babies at birth. The difference in weight between colored boys and colored girls continues negligible down to about the sixteenth week, when the difference is 284 grams. The boys are from 284 grams to 567 grams heavier from the sixteenth week to about the thirty-fifth week; from that time on the sexes differ less and less until at the fifty-second week the average weight for girls is 8474 grams and for the boys 8423 grams. The amount of difference between the average weights of the colored girls and the white girls varies a great deal. The white girls are heavier at birth, but the difference becomes less shortly after. From the period between the sixth and sixteenth weeks to the end of the first year the white girls are heavier, with the difference gradually increasing until at the end of the fifty-second week the white girls weigh 454 grams more than the colored girls.

The individual weights for the colored girls, as for the colored boys, show more irregularity than the weights of the white girls.

a. *Effects of Artificial Feeding.* Fifty per cent of the 16 artificially fed babies are 907 grams or more lighter than the average weight at 20 weeks, and at the end of the year

TABLE VI

MEAN WEIGHT AND MEAN DEVIATION OF 100 FEMALES—COLORED

Number of Cases	Age in Weeks	Grams	
		Weight	Mean deviation
70	Birth	3340	445
18	1	3439	377
55	2-3	3496	493
44	4-5	3892	374
56	6-7	4159	553
48	8-9	4590	559
44	10-11	4794	559
43	12-13	4964	646
48	14-15	5395	610
48	16-17	5299	842
50	18-19	5681	890
42	20-21	5778	808
54	22-23	6265	822
41	24-25	6124	870
42	26-27	6447	933
37	28-29	6362	1089
44	30-31	6736	958
38	32-33	7133	947
29	34-35	7022	936
45	36-37	7351	783
38	38-39	7450	902
28	40-41	7717	848
32	42-43	7552	720
39	44-45	8083	907
22	46-47	7978	853
27	48-49	8054	944
35	50-51	8304	771
32	52-53	8474	771
27	54-55	8341	978
20	56-57	8431	819
22	58-59	8375	890
1214			

there are still seven out of 14 who are decidedly below average. The records show that several of the mothers worked or boarded out, which would interfere with the regularity of feeding and proper care, and this might account for the fact that these babies did not gain so much weight as the white babies who were artificially fed.

b. *Effects of Disease.* There are only half as many illnesses recorded for these colored girls as for the whites. The most frequent disease in every case is diarrhea, although it seldom has much

effect on growth in weight. Four out of 116 babies died during the first year, one from pneumonia and one from intestinal indigestion; in the case of the other two, no cause was given. It is probable that the record of illness is not complete, a fact which would partially account for the apparently more healthy condition of the colored girls.

The diet records show greater dependence on milk in some form for additional nourishment during the first 11 months than in the case of the white girl babies. In most cases the babies are given condensed milk or modified cow's milk besides the breast feedings, soon after the sixth month. Many of the white girl babies are given cereals, broth, rice, potato, or bread, but only a few colored babies are given this kind of food until the end of the year. This may have something to do with the fact that the white girls are heavier the last six months, although the colored babies are heavier up to the fifth month.

5. Colored Male Babies

The weights for colored boys show more irregularity in growth than in the case of white boys. The average weight at birth for the colored boys is 3408 grams and for the white boys 3629 grams. Throughout the year the difference in weight varies a great deal, but the average weight for the colored boys is less than that of the white boys at every period except the 24 to 25 weeks period when it is just the same. The general tendency, however, is for the difference to be greater as the children get older. For example, at birth the difference is 221 grams, at the 16 and 17 weeks period it is 447 grams, and at the 52 and 53 weeks period it is 876 grams.

The individual cases show the same irregularity in growth. There will be several weeks during which the increase in weight will be negligible, and no disease will be indicated on the record. The number of illnesses recorded for the colored boys is just about the same as for the white boys. Apparently, their growth is more retarded by home conditions and a general lack of care than an unusual amount of sickness.

a. *Effects of Artificial Feeding.* In the case of the colored boys, more of the artificially fed babies are below normal than in the case of the white boys. Out of 11, eight are more than 907 grams below average weight in the twentieth week. At the end of one year, six are still 907 grams or more below average, although the

TABLE VII

MEAN WEIGHT AND MEAN DEVIATION OF 100 MALES—COLORED

Number of cases	Age in weeks	Grams	
		Weight	Mean Deviation
60	Birth	3408	479
15	1	3473	508
52	2-3	3558	564
46	4-5	3924	649
40	6-7	4088	734
53	8-9	4584	737
49	10-11	4950	765
47	12-13	5165	882
40	14-15	5162	1055
41	16-17	5591	938
50	18-19	5936	961
39	20-21	6109	981
46	22-23	5973	941
42	24-25	6792	822
39	26-27	6926	785
35	28-29	6849	839
42	30-31	7190	882
35	32-33	6991	964
37	34-35	7436	1052
32	36-37	7371	879
35	38-39	7558	984
31	40-41	7669	848
29	42-43	7660	930
27	44-45	8051	953
27	46-47	8343	947
27	48-49	8219	828
25	50-51	8386	936
34	52-53	8423	683
29	54-55	8771	975
17	56-57	9001	788
1121			

only illnesses recorded for these babies are one case of whooping cough and one of thrush.

b. *Effects of Disease.* The number of serious illnesses is much greater than for the white boys. There are 12 cases of pneumonia recorded, four times as many as for the white boys, and of those eight died. Six others died from diseases which are not recorded for the white babies, such as cholera infantum, tuberculosis, lues, and marasmus. The effect of the more common diseases, such as diarrhea, bronchitis, eczema, whooping cough, measles, and

constipation is practically the same as for the white boys, loss of weight is very similar and recovery is equally rapid.

6. Individual and Average Growth Curves of White Male and Female Babies

The three boys whose weight curves are given in Chart III are taken from the group of 100 whose averages have been given on page 39. Their measurements extend over the year period in most cases, but the curves have been limited to 52 weeks' measurements on the same individuals at more or less regular intervals.

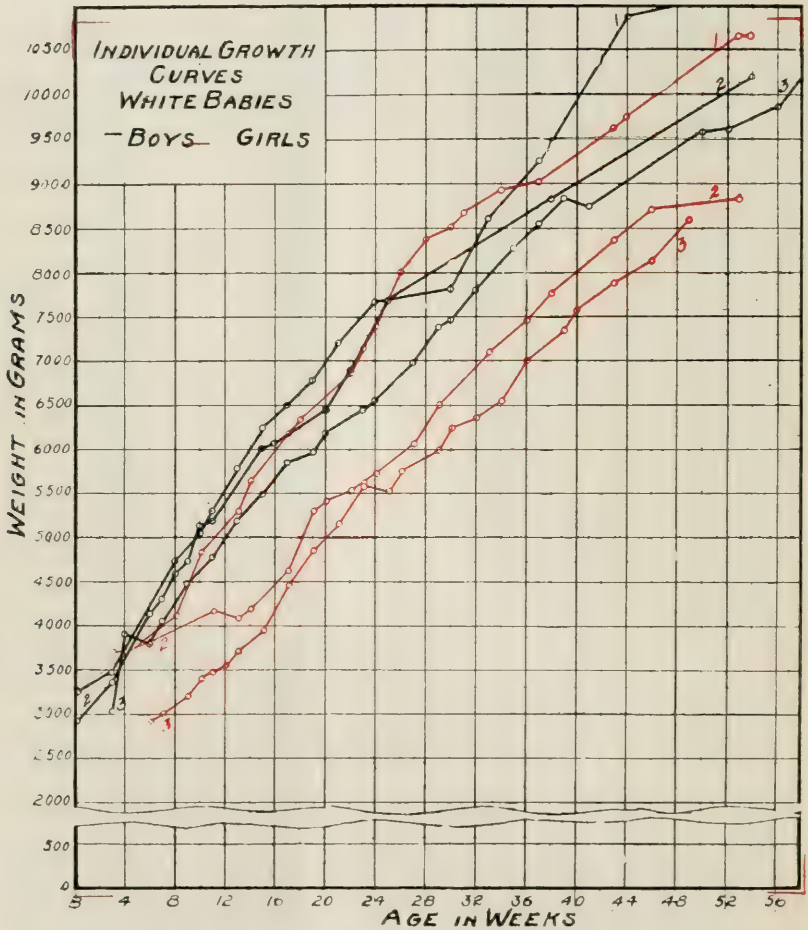


Chart III

The heaviest boy (*1*), of Hebrew parentage and a twin, weighed 3288 grams at birth and grew in a normal healthy manner until the end of the year, when he weighed 11,113 grams. There was a slight drop in weight after August. He was breast fed with a milk formula at six months and some solid food at nine months. At the end of the year he was taking soft food and the breast. There were no intercurrent illnesses during the year. There were eight living children, all breast fed. The father was 40, the mother 38 years of age.

The second boy (*2*), a Russian Hebrew, also shows good healthy growth in weight. His birth weight was 2948 grams, and he was breast fed during the year, with a soft diet at 12 months, and there were no intercurrent illnesses. At 12 months he weighed 10,087 grams. This boy also shows a slight falling off in weight after 24 weeks (August-September). At the end of the year his diet consisted of milk, soup, zwieback, and oatmeal. The father was 28 and the mother 26 years of age and there were two living children, breast fed.

The third boy (*3*) is also of Russian descent. His weight at birth is not recorded, but at the end of the second week he weighed 3062 grams. He had an abscess in the right axilla at four weeks, and suffered from constipation at nine weeks, bronchitis at 24 weeks and acute coryza at 40 weeks. After 32 weeks he was fed cereal every three hours, the breast feeding having been discontinued. The father was 27 and the mother 21 years of age. This was the only child.

The girls' curves of growth in weight (Chart III page 44) are slightly below those of the boys and are slightly more irregular. Number (*1*), of German descent, weighed 3402 grams at birth and 10,659 grams at the end of the year. She was breast fed for eight months, after which a cow's milk formula was used. She had no intercurrent illness and was the only child of young parents, aged 22 and 23 respectively.

The second child (*2*), of American parentage, shows a relatively high weight at the third week, the birth weight being unknown. At the end of the eighth week the mother's milk was exhausted and cow's milk was substituted. The child never regained its relative position in weight. There was no illness during the year. The father and mother were 28 and 29 years old respectively.

The third girl (*3*), of German Hebrew parentage, was given con-

densed milk from the first, as "the mother's milk did not agree with the baby." Later cow's milk and at seven months broth, zwieback, and cereal were given. She had no intercurrent illnesses. Growth is steady and uniform, although the child is relatively light. Both parents were 27 years old and there were no other children.

In this group of babies there is a wider range of distribution than with the previous group. No. (*1*) of American descent, is a large, fat boy, weighing 4536 grams at birth and 11,567 grams at the end of the 52 weeks. He was breast fed and had no illness except diarrhea at 28 weeks, followed by a slight loss in weight. He was breast fed with supplementary cereals and soft food after 32 weeks. The father was 32 years of age and the mother 28. There was an older child.

The second boy (*2*), a Russian Hebrew, weighed 2948 grams at birth. While he was small, growth was good for the first 30 weeks, when there began a slight diminution. No diseases were present during the year. He was breast fed for nine months, with cereal and zwieback, beginning at six months, broth and eggs at nine months and soft food at 12 months. The father was 20 and the mother 19 years of age and this was the only child.

The largest girl (*1*) was large at birth, weighing 5216 grams, with a subsequent history of bronchitis at 23 weeks, rhinopharyngitis at 40 weeks and ilio-colitis at 52 weeks. She was breast fed for the first 16 weeks, when cow's milk was substituted, followed by cereals and finally protein milk. The child was not taken for observation until 12 weeks (June 27th) when it weighed 5727 grams, having gained but 510 grams during the period of 13 weeks. The value of subsequent observations and directions is self-evident. There were four children, two of whom had died in infancy. The parents were 33 years old respectively.

The second girl (*2*), of German Hebrew descent, weighed 3402 grams at birth and 9129 grams at the end of the year. She was breast fed for seven months, was then given cereals and broth and later soft food. There is a dropping off in the relative weight after the 24th week (August 26th). She was the only child of parents aged 29 and 26 respectively.

The smallest girl (*3*), of American descent, weighing 1814 grams at birth, was immediately brought to the Station at the end of the first week and grew rapidly until an acute illness at 34 weeks. This girl was breast fed for eight weeks, when the mother's milk failed

and condensed milk was substituted. There were three children of whom one, bottle fed, died. The father was 30 years of age and the mother 29.

7. Individual and Average Growth Curves of Colored Male and Female Babies

In this group of three colored boys, the measurements in weight extend, like those of the white boys, from birth to 56 weeks but the

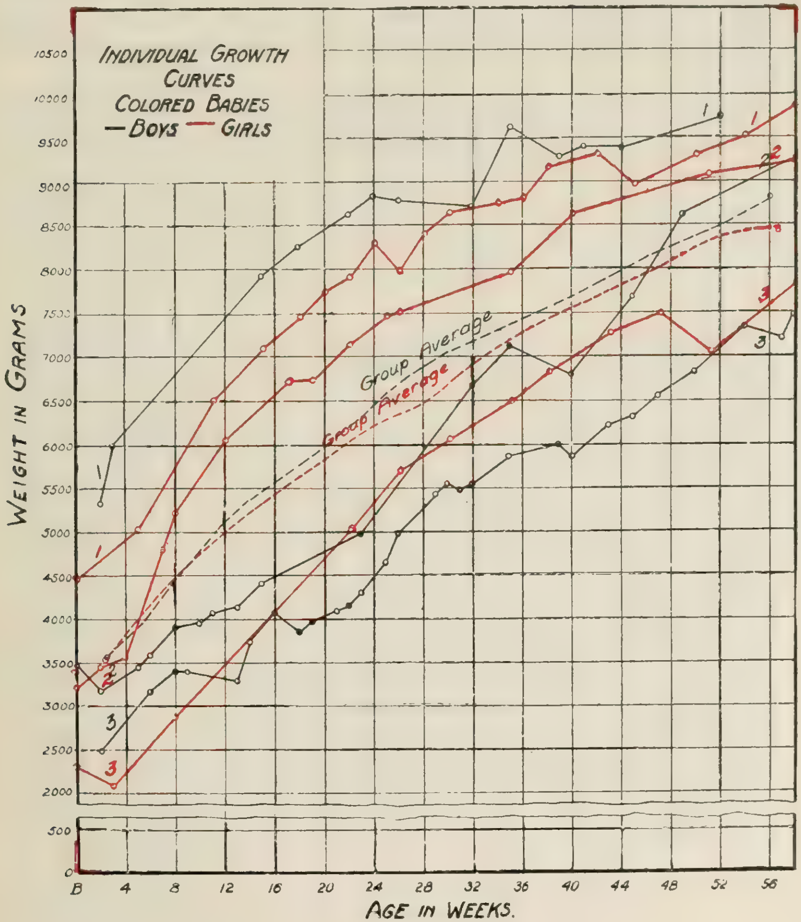


Chart IV

number of regular observations is less except in the case of the third. The birth weight of the largest (*1*) was not known, but at

the end of two weeks he weighed 5330 grams and at the end of the year 9752. No illnesses are recorded and the baby is an unusually large one. He was the last born of six children, two having died; all were breast fed. The father was 38 years of age, in good health and the mother 36, in good health.

The second colored boy (*2*) weighed 3515 grams at birth and grew steadily and fairly uniformly until he weighed 9979 grams at the end of the first 68 weeks. He had no serious diseases. He was breast fed for the first two weeks only, when cow's milk was substituted. He was the second child and both parents were 32 years old.

The third boy (*3*) was small, weighing 2495 grams at the end of two weeks; he had little or no illness except thrush at 45 weeks and grew well under careful observation during the 28 visits to the Station. He lived on condensed milk for eight weeks, cow's milk until 36 weeks and cereal and soft food after this. His parents were said to be healthy. The father was 40 years old and the mother 17 years old.

The growth curves for weight in this group of non-selected colored girls are more regular than for the boys, and the range is smaller. No. (*1*) weighed 4423 grams at birth and 9866 grams at the 56th week. No illness was apparent and she was breast fed for the first 48 weeks with supplementary feedings of cow's milk after 16 weeks and cereals at 44 weeks. Her mother brought her frequently to the Station for observation and for advice for herself. The father was 38 and the mother was 27. This was the only child.

The second girl (*2*) weighed 3175 grams at birth and 9979 grams at the 83rd week. No serious illness is recorded. She was breast fed for 36 weeks. The parents were young, the father being 20 and the mother 18 years of age; this girl was the first child.

The smallest girl (*3*) did not make many visits to the Station —12 during the 56 weeks. No illness is recorded. She was breast fed for 52 weeks. She was the second child, the parents being 33 and 21 respectively.

8. DISTRIBUTION OF RECORDED PREVALENT DISEASES

TABLE VIII

DISTRIBUTION TABLE OF PREVALENT DISEASES RECORDED DURING FIRST 57 WEEKS (400 BABIES)

Diseases	White boys Number of times disease appears	White girls Number of times disease appears	Colored boys No. of times disease appears	Colored girls No. of times disease appears
Diarrhea	11	34	8	11
Eczema	4	37	4	3
Vomiting		8	4	2
Bronchitis	8	7	5	3
Whooping cough	2	7	2	3
Constipation	3	6	2	2
Otitis media	4	4		5
Coryza	2	4	1	1
Intest'l indigest'n		3		2
Cough		3	1	
Pneumonia	4	3	12	4
Measles	1	2	4	
Colds	1	2	1	3
Chicken pox		2		1
Scarlet fever		1		
Acute mastoiditis		1		
Pharyngitis	1	1		
Rhino-pharyngitis		1		
Thrush	3		1	
Tonsilitis	2			
Impetigo	2			
Abscess	2			
Sore throat	1			
Mumps	1		1	
Cervical adenitis	1			
Furunculosis	1			
Convulsions			2	2
Rickets			3	2
Stomatitis				1
Rales				1
Rash on face				1
Eruptions				1
Poliomyelitis			2	
Cholera infantum			1	
Osteomyelitis			1	
Pyloris stenosis			1	
Papular eruption			1	
Sup'rat'g parotitis			1	
Arthritis			1	
Syphilis			2	
Marasmus			1	
Tuberculosis			1	
Total	54	126	63	50

9. Computation of Correlations for:

a. *White Females.* For the white baby girls the coefficients of correlation* between the weight at birth and weight at 14-15 weeks is + .537 with P. E. ± .082; between weight at birth and the 34-35 weeks + .124 with P. E. ± .117; and between weight at birth and the 52-54 weeks + .436 with P. E. ± .113.

b. *White Males.* The coefficient of correlation between weight of white baby boys at birth and weight at 14-15 weeks is + .263 with P. E. ± .110; between weight at birth and the 34-35 weeks + .077 with P. E. ± .125; and between birth and the 46-47 weeks + .308 with P. E. ± .139.

c. *Colored Females.* For the colored baby girls the coefficient of correlation between weight at birth and weight at 12-13 weeks is + .584 with P. E. ± .108; between weight at birth and the 34-35 weeks, + .045 with P. E. ±.077; and between weight at birth and the 52-53 weeks, ± .481 with P. E. + .118.

d. *Colored Males.* For the colored baby boys the coefficient of correlation between weight at birth and weight at 14-15 weeks is + .649 with P. E. ± .075; between weight at birth and the 35-36 weeks, +.413 with P. E. +.107; and between weight at birth and the 50-51 weeks; + .191 with P. E. ± .135.

10. Conclusions

This study of 4800 consecutive measurements in weight on 200 white babies and 200 colored babies approximating normal development shows that for this group:

I. For these infants at birth, the boys and girls weigh approximately the same. The white boys gain in weight more rapidly than the girls and are 454 grams to 681 grams heavier from the second month to the thirteenth month. The colored boys are from 284 to 567 grams heavier than the girls between the fourth and ninth months, but lose this advantage by the end of the year.

II. For this group of infants the colored babies, both boys and girls, weigh on an average 227 grams less than the white babies. This difference becomes greater until at the end of one year the colored babies weigh from 454 to 907 grams less than the white babies, both boys and girls.

III. As a rule, the babies that are relatively heavy at birth are

* Pearson formula.

heavy at the age of four months, and those that are light at birth remain relatively light. On an average, these boys double their birth weight at the end of the seventh month, and the girls at the end of the eighth month.

IV. The coefficients of correlation between weight at birth and weight in the 14 to 15 weeks period are, for white girls +.537, for white boys +.263; for colored girls +.649, and for colored boys +.584. This coefficient decreases as we approach the 34 to 35 week periods, until with the end of the year there is no positive correlation for this group of children. It is not possible to prophesy with a high degree of assurance that if one of these children is heavy at birth, he or she will be relatively heavy at the end of the first year.

V. From 60 to 70 per cent of the babies who are above the average weight at the beginning of the first year are still above average at the end of the year and vice versa, with considerable individual variation within these ranges. They vary a great deal as to the amount they are above or below during this period.

VI. These artificially fed babies as a rule weigh less than the breast fed babies; this is particularly noticeable during the first few months.

VII. The individual growth curves during the first year show a wide range of individual and racial differences at all weekly periods.

11. Supplementary Data Based on Group of Infants Studied

1. The most frequent infant disease recorded for these children is diarrhea, but this has no serious noticeable effect on growth if checked soon and no other complications set in.

2. Bronchitis, constipation, indigestion, otitis media, coughs, and colds, retard growth if allowed to continue for several weeks.

3. Pneumonia is a serious disease from the standpoint of growth for these infants. It occurs more frequently with the colored children than with the white. There are seven cases of pneumonia reported for the white babies and 16 for the colored babies.

4. The white girls show 50 per cent more illness recorded than the white boys.

5. For this group of children, digestive disturbances are more important in interfering with growth than are respiratory disturbances.

II. COMPARATIVE NORMS FOR INFANTS

1. Sources of Data

The infant growth curves for height for boys and girls from Baldwin, Crum, Variot and Fliniaux and Schmid-Monnard are included in this section of the study for comparative purposes.

2. Growth Curves in Height—Males and Females

Chart V, below, represents the height of infants according to

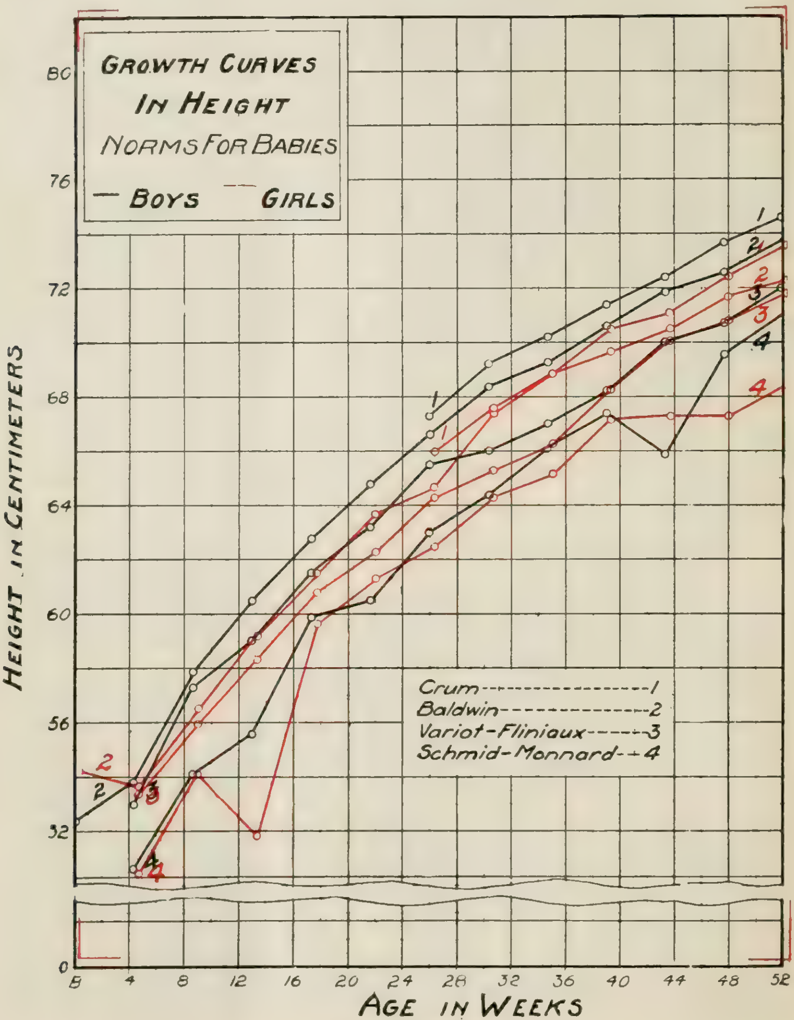


Chart V

these investigators, the black lines showing the growth of boys and the red lines the growth of girls. The norms of Baldwin (*2*) derived from a study of infants in the 99 counties of the State of Iowa are here published for the first time. The methods of collecting these data are described on page 58. The figures used for constructing the growth curves of Crum (*1*) are taken from his Anthropometric Table compiled for the American Medical Association from the measurements of children in 31 states—usually at baby

TABLE IX

HEIGHT AND WEIGHT OF IOWA INFANTS
4682 Boys; 4392 Girls; Total 9074

BOYS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	29	52.38	4.00	.076(.42)*
Under 1 month	124	53.83	4.15	.077(.43)
1 month under 2 mos.	307	57.93	5.15	.089(.50)
2 mos. under 3 mos.	341	60.50	5.92	.098(.55)
3 mos. under 4 mos.	408	62.81	6.49	.103(.58)
4 mos. under 5 mos.	364	64.76	7.10	.110(.63)
5 mos. under 6 mos.	393	66.58	7.50	.113(.63)
6 mos. under 7 mos.	399	68.38	8.03	.117(.65)
7 mos. under 8 mos.	413	69.25	8.36	.121(.68)
8 mos. under 9 mos.	363	70.62	8.68	.123(.69)
9 mos. under 10 mos.	370	71.94	8.95	.124(.69)
10 mos. under 11 mos.	394	72.60	9.11	.125(.70)
11 mos. under 12 mos.	376	73.80	9.40	.127(.71)
12 mos. under 13 mos.	396	74.69	9.54	.128(.72)

GIRLS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	24	53.87	4.25	.079(.44)*
Under 1 month	95	53.34	3.98	.075(.42)
1 month under 2 mos.	278	56.21	4.63	.082(.46)
2 mos. under 3 mos.	345	58.88	5.39	.092(.51)
3 mos. under 4 mos.	392	61.23	6.04	.099(.55)
4 mos. under 5 mos.	380	63.36	6.58	.104(.58)
5 mos. under 6 mos.	355	64.39	7.00	.109(.61)
6 mos. under 7 mos.	363	67.12	7.54	.112(.63)
7 mos. under 8 mos.	351	68.58	7.97	.116(.65)
8 mos. under 9 mos.	378	69.35	8.19	.118(.66)
9 mos. under 10 mos.	321	70.23	8.34	.119(.66)
10 mos. under 11 mos.	393	71.40	8.61	.121(.68)
11 mos. under 12 mos.	369	72.03	8.77	.122(.68)
12 mos. under 13 mos.	348	73.15	9.17	.125(.70)

* English measure

contests. The data collected for the curve of Variot and Fliniaux (3) and reported to the Academy of Science at Paris 1914 represent the growth of breast-fed infants. Schmid-Monnard's (4) curve represents the growth of breast-fed children in Frankfurt am Main, 1891-92.

The figures upon which these charts were constructed are given in the comparatives tables for infants, Part V. The number of cases

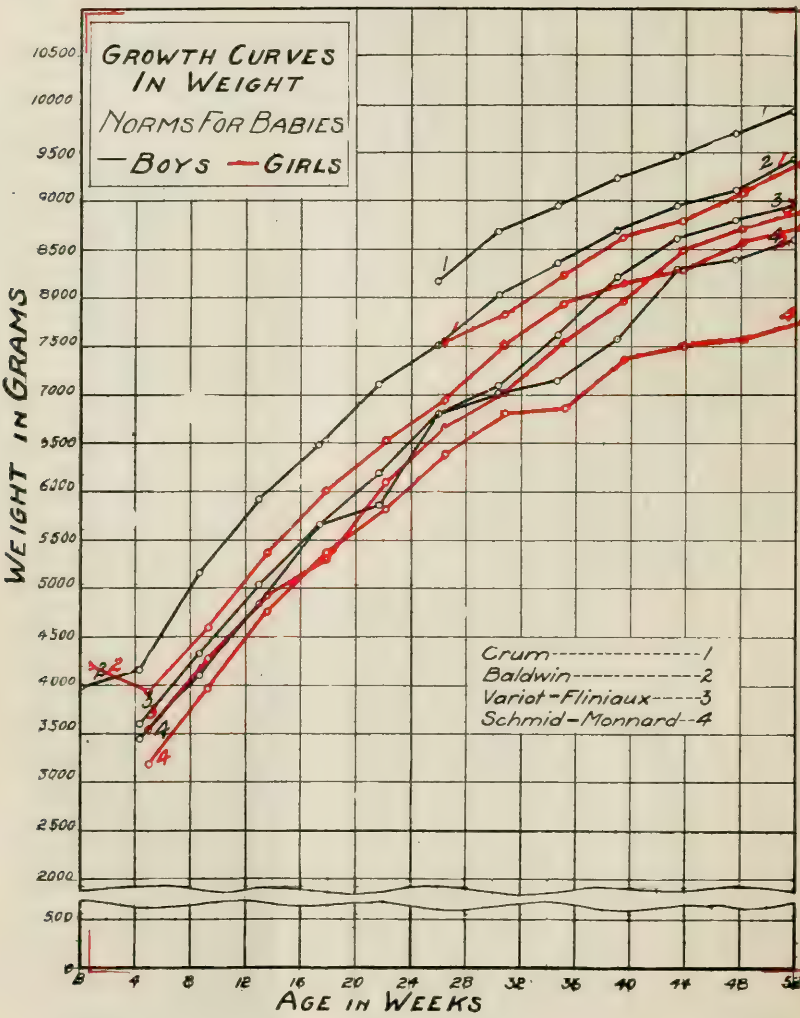


Chart VI

used to obtain the averages are given (when the investigator's own report includes them) in the footnotes to the comparative tables.

3. Growth Curves in Weight—Males and Females

Chart VI page 54 represents the weight of infants reported in the same investigations as those mentioned above for height, and the curves are numbered the same.

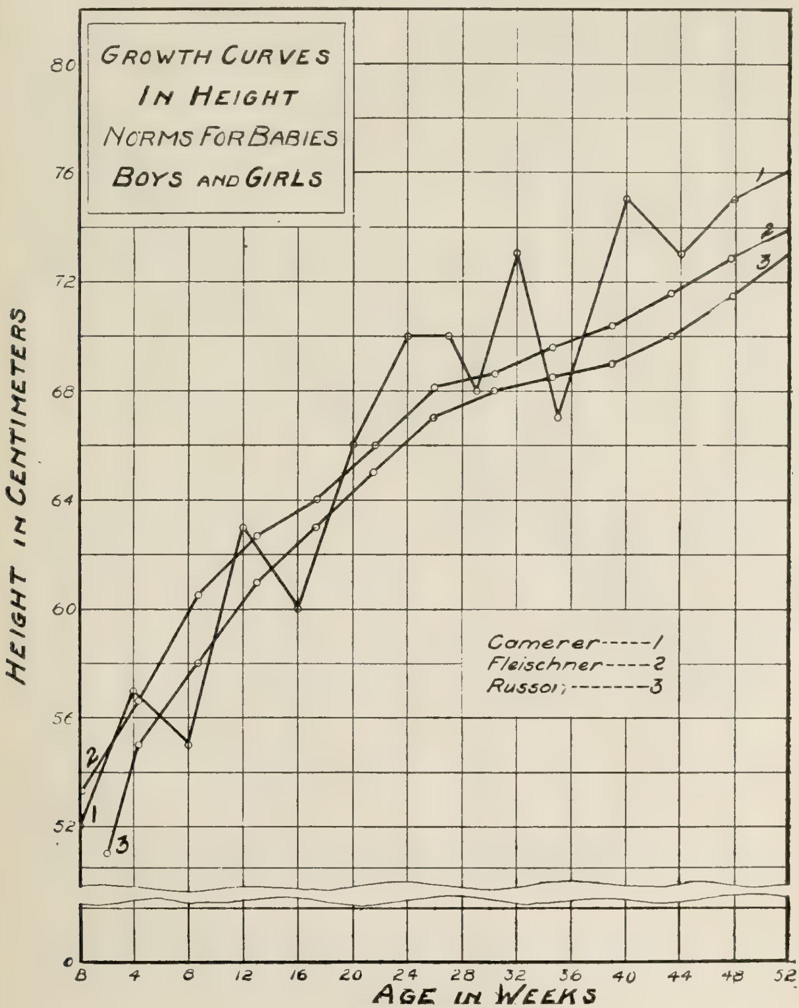


Chart VII

4. Growth Curves in Height—Males and Females Combined

Chart VII page 55 gives the height of infants according to three investigators who combined the measurements of boys and girls in obtaining an average. The figures for the curve of Fleischner (2) were computed from his table of increments for well-nourished American infants published in 1906. Camerer's (1) curve represents the height of breast-fed boys and girls

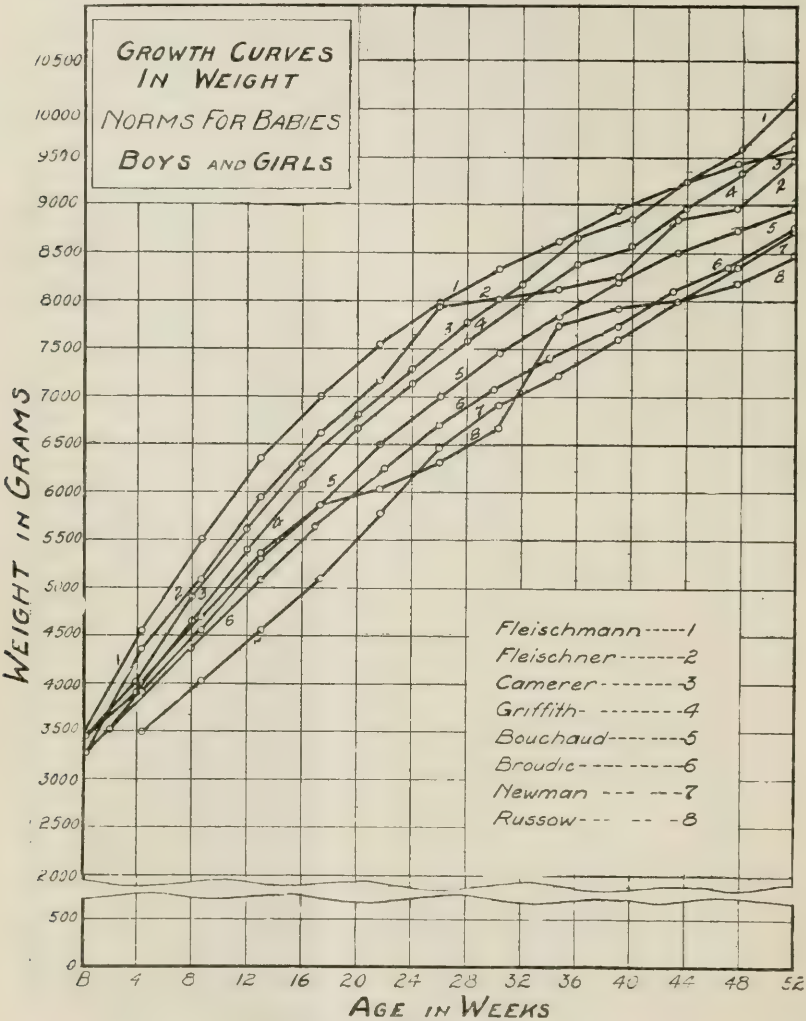


Chart VIII

(German). These data were published in 1901. The curve of Russow (*3*) also represents the height of breast-fed German infants. These figures were published in 1881.

5. Growth Curves in Weight—Males and Females Combined

In Chart VIII page 56 representing the weight of infants (sexes combined) these three investigators, Camerer (*3*), Fleischner (*2*) and Russow (*8*) are again represented, in addition to five others. The figures upon which the curve of Griffith (*4*) was constructed were estimated from a graph in his *Diseases of Infants and Children*. The actual measurements upon which his own graph was constructed seem never to have been published in table form. Presumably they represent the growth of American infants. The figures for Bouchaud's (*5*) curve for French infants were published in 1864. Broudic's (*6*) curve shows the growth of French infants (breast and bottle fed) according to measurements published in 1919. The figures upon which the curve for Newman (*7*) was drawn are quoted from Robertson who believes this Newman standard commonly used in England is really derived from French infants. The data of Fleischmann's (*1*) curve, obtained from German children, were published in 1877.

6. Conclusions

I. The Crum charts and tables, beginning at six months, for 2945 selected infants at baby contests are too high for norms for American children in general.

II. The curves of Baldwin and the Federal Children's Bureau for 9074 infants from birth to 12 months are the most satisfactory available normal standards for American children for height and weight. In weight they tend to drop below the best posited standard after six months.

III. French and German infants are inferior to American infants in height and weight during the first year of infancy.

IV. The growth curves of Fleischner, Camerer and Russow are not reliable as norms for height, since they do not take account of sex differences.

V. The combined weight curves of Camerer, Fleischner, Russow, Griffith, Bouchaud, Broudic, Newman, and Fleischmann are not reliable, since they do not differentiate between males and females.

CHAPTER IV

GROWTH OF PRE-SCHOOL CHILDREN

1. Methods of Collecting Data

Table X on page 60 gives the average height, weight, and weight-height indices of 36,958 boys and girls between the ages of birth and 72 months, from the 99 counties of Iowa. The measurements should be especially good, having in all cases been made on nude children by a physician of good standing or a graduate nurse. In the State of Iowa approximately 140,000 children were weighed and measured, but all except those of the approved class were eliminated, including those having any defect or disease which necessarily interferes with the growth and nutrition of the child. The original data were collected during the National Children's Year campaign from April to June, 1918, under the direction of the Federal Children's Bureau, the Child Welfare Research Station, the Women's Committee of the Council of National Defense, with the coöperation of the Federated Women's Clubs, Parent Teachers Association, Woman's Christian Temperance Union, and other agencies, in accordance with a general policy agreed upon at a conference at Fort Dodge, March 5th, 1918, at which the writer and Dr. Ellsworth Faris, who later became Acting Director during the war, were present. Iowa had the larger proportion of her children weighed and measured. The proportion of children included in the tabulation, *i. e.* those reported by physicians as weighed and measured without clothing, was larger in Iowa than in any other state, approximately 13 per cent of the estimated white population of Iowa under six years of age having been included in the tabulation. The public interest aroused during the collection of these data in each of the 99 counties of the State has resulted in a state-wide demand for permanent clinics, public health nurses, school physicians and child welfare stations.

Through the courtesy of the office of the Federal Children's Bureau the original cards from Iowa were tabulated and the averages furnished the writer, who, in turn, has transferred them

into the metric system, worked out the weight-height indices and constructed the charts on pages 63 to 64. The results furnish new and reliable standards of growth for pre-school children.

The tendency, which may be noted in Table X, for Iowa children to drop back proportionately in weight is due, no doubt, to several factors, including the lack of proper nutrition and medical inspection. That it is not due to the predominance of any particular foreign-born population may be gleaned from the nativity distribution of Iowa's total population in 1915. The 1920 census shows approximately the same distribution with a total population of 2,403,630.

Nativity group	Number	Percent
All nativities	2,358,066	100.0
Native white of native parents	1,422,464	60.3
Native white of foreign or mixed parentage	654,855	27.8
Foreign-born white	264,003	11.2
Germany, Austria, Bohemia, Hungary	106,905	4.5
British Isles and Canada	48,115	2.0
Denmark, Norway and Sweden	64,877	2.8
Holland	12,638	.5
Russia	9,869	.4
Other foreign	21,599	1.0
Colored	16,744	.7

The advance sheets of the tabulation from the Federal Bureau by Dr. Robert M. Woodbury show that in Iowa 82.2 per cent of the 37,033 children under seven years of age are of native parentage with 7.9 percent of both parents foreign-born in the same country, and 7.2 percent in different countries. In this study 296 of the children were of Italian parentage (relatively short people), 1043 Scandinavian parentage (relatively tall people), 975 of German parentage, and 217 of negro parentage. The latter group of 217 negroes was not included in the above table. The rural children it was found are slightly above the urban in height and weight for these ages from birth to six years, for both boys and girls. The Iowa children are slightly below the California children in height and weight, and decidedly above the New York children.

"The measurements of the Iowa children approximate those of the children in the country as a whole, with a slight excess, a fifth

of an inch, in stature. Children under one year of age are nearly three ounces heavier, but those one year or over are from one to three ounces lighter than the average for the country as a whole." (From the advance Report of the Federal Bureau.)

TABLE X

HEIGHT AND WEIGHT OF IOWA PRE-SCHOOL CHILDREN
18,770 Boys; 18,188 Girls; Total 36,958.
Age: From Birth to Six Years

BOYS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	29	52.38	4.00	.076(.43)*
Under 1 month	124	53.83	4.15	.077(.43)
1 month under 2 mos.	307	57.93	5.15	.089(.50)
2 mos. under 3 mos.	341	60.50	5.92	.098(.55)
3 mos. under 4 mos.	408	62.81	6.49	.103(.58)
4 mos. under 5 mos.	364	64.76	7.10	.110(.61)
5 mos. under 6 mos.	393	66.58	7.50	.113(.63)
6 mos. under 7 mos.	399	68.38	8.03	.117(.66)
7 mos. under 8 mos.	413	69.25	8.36	.121(.68)
8 mos. under 9 mos.	368	70.62	8.68	.123(.69)
9 mos. under 10 mos.	370	71.94	8.95	.124(.70)
10 mos. under 11 mos.	394	72.60	9.11	.125(.70)
11 mos. under 12 mos.	376	73.80	9.40	.127(.71)
12 mos. under 13 mos.	396	74.69	9.54	.128(.72)
13 mos. under 14 mos.	285	75.96	9.80	.129(.72)
14 mos. under 15 mos.	306	76.56	10.01	.131(.73)
15 mos. under 16 mos.	301	77.70	10.09	.130(.73)
16 mos. under 17 mos.	310	79.09	10.42	.132(.74)
17 mos. under 18 mos.	307	79.39	10.61	.134(.75)
18 mos. under 19 mos.	307	80.36	10.76	.134(.75)
19 mos. under 20 mos.	292	82.06	11.12	.136(.76)
20 mos. under 21 mos.	284	82.87	11.25	.136(.76)
21 mos. under 22 mos.	278	83.73	11.52	.138(.77)
22 mos. under 23 mos.	293	84.52	11.72	.139(.78)
23 mos. under 24 mos.	327	84.85	11.72	.138(.77)
24 mos. under 25 mos.	316	85.84	11.92	.139(.78)
25 mos. under 26 mos.	302	86.67	12.23	.141(.79)
26 mos. under 27 mos.	305	87.00	12.27	.141(.79)
27 mos. under 28 mos.	287	87.77	12.34	.141(.79)
28 mos. under 29 mos.	312	88.25	12.56	.142(.80)
29 mos. under 30 mos.	339	88.59	12.76	.144(.81)
30 mos. under 31 mos.	305	89.35	12.87	.144(.81)
31 mos. under 32 mos.	273	91.18	13.26	.145(.81)
32 mos. under 33 mos.	270	91.34	13.48	.148(.83)
33 mos. under 34 mos.	321	91.85	13.44	.146(.82)
34 mos. under 35 mos.	300	92.45	13.67	.148(.83)

35 mos. under 36 mos.	307	92.77	13.71	.148(.83)
36 mos. under 37 mos.	301	93.74	13.98	.149(.84)
37 mos. under 38 mos.	293	94.11	13.96	.148(.83)
38 mos. under 39 mos.	293	94.84	14.19	.150(.84)
39 mos. under 40 mos.	296	95.47	14.32	.150(.84)
40 mos. under 41 mos.	292	95.77	14.42	.151(.84)
41 mos. under 42 mos.	304	96.33	14.62	.152(.85)
42 mos. under 43 mos.	285	97.62	14.94	.153(.86)
43 mos. under 44 mos.	284	97.98	15.01	.153(.86)
44 mos. under 45 mos.	285	98.82	15.04	.152(.85)
45 mos. under 46 mos.	295	99.29	15.44	.156(.87)
46 mos. under 47 mos.	285	99.28	15.35	.155(.87)
47 mos. under 48 mos.	324	100.14	15.52	.155(.88)
48 mos. under 49 mos.	266	99.93	15.86	.159(.89)
49 mos. under 50 mos.	248	100.77	15.59	.155(.87)
50 mos. under 51 mos.	229	101.64	15.82	.156(.87)
51 mos. under 52 mos.	238	101.70	15.94	.157(.88)
52 mos. under 53 mos.	267	102.10	16.10	.158(.88)
53 mos, under 54 mos.	252	102.74	16.27	.158(.89)
54 mos. under 55 mos.	248	103.16	16.22	.157(.88)
55 mos. under 56 mos.	247	104.01	16.34	.157(.88)
56 mos. under 57 mos.	232	104.99	16.73	.159(.89)
57 mos. under 58 mos.	246	105.28	16.85	.160(.90)
58 mos. under 59 mos.	253	105.52	16.95	.161(.90)
59 mos. under 60 mos.	248	105.80	16.94	.160(.90)
60 mos. under 61 mos.	100	106.35	17.19	.162(.91)
61 mos. under 62 mos.	79	106.65	17.27	.163(.91)
62 mos. under 63 mos.	61	107.72	17.51	.163(.91)
63 mos. under 64 mos.	57	106.95	17.26	.161(.90)
64 mos. under 65 mos.	69	107.23	17.51	.163(.91)
65 mos. under 66 mos.	76	108.82	17.74	.163(.91)
66 mos. under 67 mos.	46	109.55	18.22	.166(.93)
67 mos. under 68 mos.	46	109.83	18.33	.167(.93)
68 mos. under 69 mos.	40	110.36	18.57	.168(.94)
69 mos. under 70 mos.	37	111.49	18.85	.169(.94)
70 mos. under 71 mos.	29	112.11	18.63	.166(.93)
71 mos. under 72 mos.	29	112.02	18.58	.166(.93)

GIRLS

Age	Number of cases	Height in Cms.	Weight in Kilogms	Weight-Height Index
At birth	24	53.87	4.25	.079(.44)*
Under 1 month	95	53.34	3.98	.075(.42)
1 month under 2 mos.	278	56.21	4.63	.082(.46)
2 mos. under 3 mos.	345	58.88	5.39	.092(.51)
3 mos. under 4 mos.	392	61.23	6.04	.099(.55)
4 mos. under 5 mos.	380	63.36	6.58	.104(.58)
5 mos. under 6 mos.	355	64.39	7.00	.109(.61)
6 mos. under 7 mos.	363	67.12	7.54	.112(.63)
7 mos. under 8 mos.	351	68.58	7.97	.116(.65)
8 mos. under 9 mos.	378	69.35	8.19	.118(.66)

9 mos. under 10 mos.	321	70.23	8.34	.119(.67)
10 mos. under 11 mos.	393	71.40	8.61	.121(.68)
11 mos. under 12 mos.	369	72.03	8.77	.122(.68)
12 mos. under 13 mos.	348	73.15	9.17	.125(.70)
13 mos. under 14 mos.	300	74.16	9.16	.124(.69)
14 mos. under 15 mos.	281	75.21	9.32	.124(.69)
15 mos. under 16 mos.	308	76.23	9.54	.125(.70)
16 mos. under 17 mos.	286	77.21	9.68	.125(.70)
17 mos. under 18 mos.	302	78.07	9.93	.127(.71)
18 mos. under 19 mos.	297	79.28	10.20	.129(.72)
19 mos. under 20 mos.	298	80.80	10.56	.131(.73)
20 mos. under 21 mos.	280	81.28	10.61	.131(.73)
21 mos. under 22 mos.	261	82.43	10.80	.131(.73)
22 mos. under 23 mos.	279	82.89	11.06	.133(.74)
23 mos. under 24 mos.	264	83.45	11.14	.133(.74)
24 mos. under 25 mos.	306	83.94	11.41	.136(.76)
25 mos. under 26 mos.	281	84.68	11.44	.135(.75)
26 mos. under 27 mos.	315	85.91	11.72	.136(.76)
27 mos. under 28 mos.	310	86.46	11.89	.138(.77)
28 mos. under 29 mos.	295	86.83	11.97	.138(.77)
29 mos. under 30 mos.	310	87.85	12.21	.139(.78)
30 mos. under 31 mos.	315	88.61	12.41	.140(.78)
31 mos. under 32 mos.	291	89.70	12.59	.140(.78)
32 mos. under 33 mos.	267	90.13	12.66	.140(.78)
33 mos. under 34 mos.	321	90.51	12.77	.141(.79)
34 mos. under 35 mos.	276	91.28	13.00	.142(.79)
35 mos. under 36 mos.	293	91.48	13.06	.143(.80)
36 mos. under 37 mos.	305	92.35	13.34	.144(.81)
37 mos. under 38 mos.	274	92.92	13.45	.145(.81)
38 mos. under 39 mos.	264	93.96	13.69	.146(.82)
39 mos. under 40 mos.	280	94.23	13.57	.144(.81)
40 mos. under 41 mos.	308	94.57	13.75	.145(.81)
41 mos. under 42 mos.	297	95.31	14.06	.148(.83)
42 mos. under 43 mos.	300	96.16	14.15	.147(.82)
43 mos. under 44 mos.	262	96.42	14.24	.148(.83)
44 mos. under 45 mos.	282	97.29	14.30	.147(.82)
45 mos. under 46 mos.	277	97.76	14.52	.149(.83)
46 mos. under 47 mos.	292	98.33	14.73	.150(.84)
47 mos. under 48 mos.	307	98.42	14.62	.149(.83)
48 mos. under 49 mos.	265	99.89	15.00	.150(.84)
49 mos. under 50 mos.	273	99.88	15.10	.151(.84)
50 mos. under 51 mos.	262	100.47	15.25	.152(.85)
51 mos. under 52 mos.	258	100.93	15.29	.151(.84)
52 mos. under 53 mos.	263	101.08	15.39	.152(.85)
53 mos. under 54 mos.	277	101.70	15.43	.152(.85)
54 mos. under 55 mos.	244	102.12	15.58	.153(.86)
55 mos. under 56 mos.	196	102.95	15.77	.153(.86)
56 mos. under 57 mos.	229	103.77	16.05	.155(.87)
57 mos. under 58 mos.	202	104.25	16.01	.154(.86)
58 mos. under 59 mos.	232	105.13	16.47	.157(.88)
59 mos. under 60 mos.	248	105.13	16.37	.156(.87)
60 mos. under 61 mos.	93	105.31	16.54	.157(.88)

61 mos. under 62 mos.	56	105.95	16.94	.160(.89)
62 mos. under 63 mos.	64	105.49	16.65	.158(.88)
63 mos. under 64 mos.	70	106.39	16.61	.156(.87)
64 mos. under 65 mos.	64	107.16	17.08	.159(.89)
65 mos. under 66 mos.	62	107.38	17.07	.159(.89)
66 mos. under 67 mos.	50	106.99	17.48	.163(.91)
67 mos. under 68 mos.	47	108.30	17.54	.162(.91)
68 mos. under 69 mos.	42	108.74	18.16	.167(.93)
69 mos. under 70 mos.	36	110.84	18.27	.165(.92)
70 mos. under 71 mos.	33	110.30	17.91	.162(.91)
71 mos. under 72 mos.	41	109.73	18.14	.165(.92)

*English measure

2. Growth Curves in Weight and Height, Iowa Boys and Girls

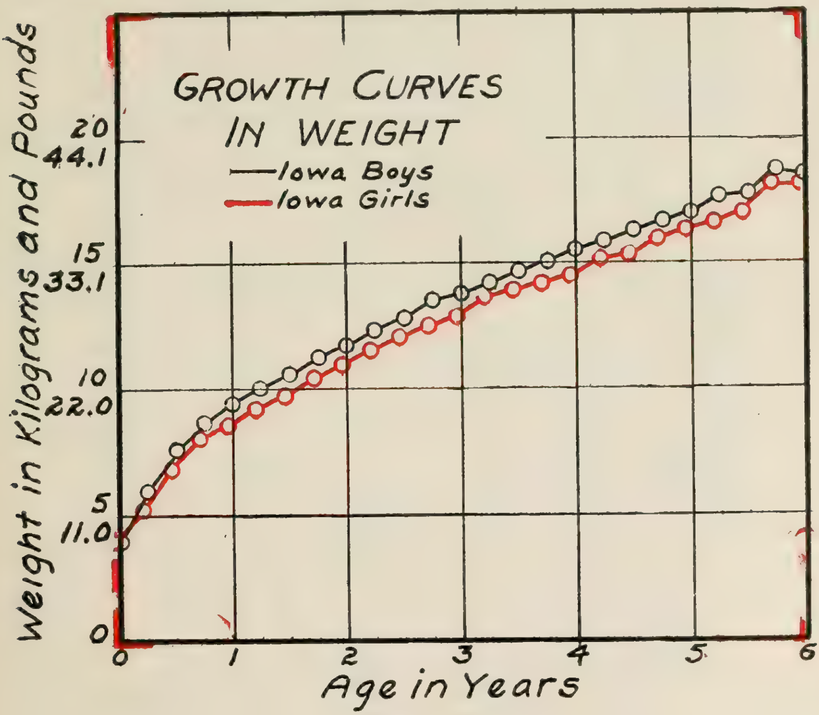


Chart IX

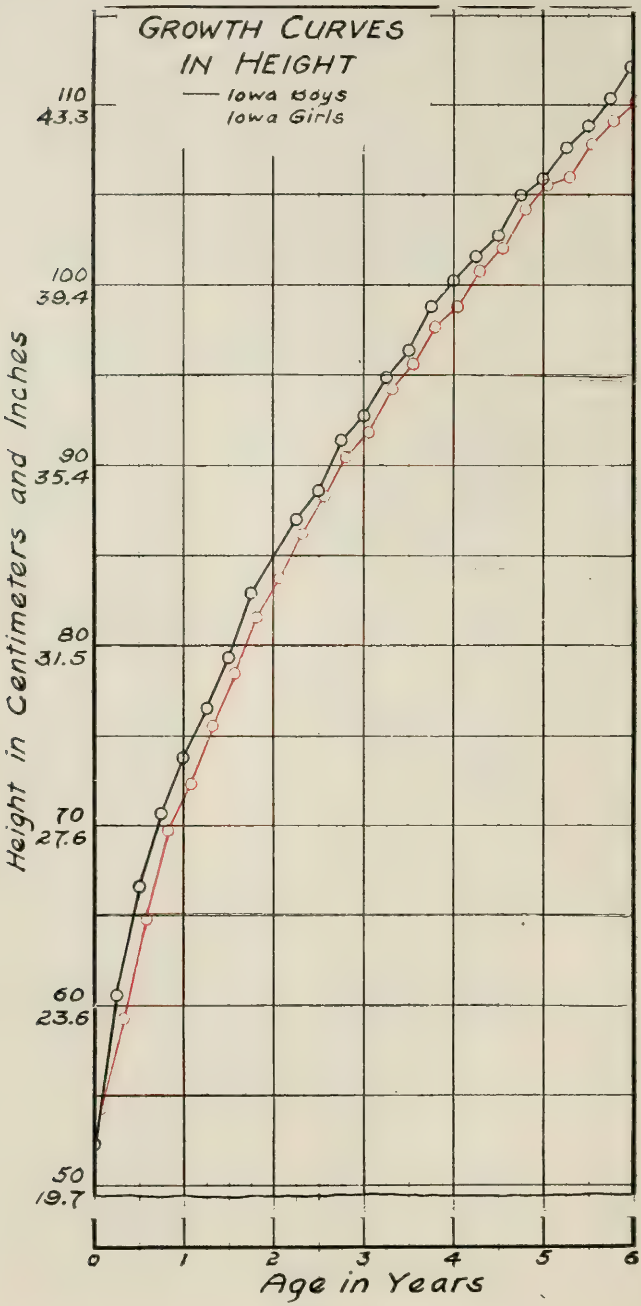

GROWTH CURVES
IN HEIGHT
— Iowa Boys
Iowa Girls
Height in Centimeters and Inches
110
43.3
100
39.4
90
35.4
80
31.5
70
27.6
60
23.6
50
19.7
0
1
2
3
4
5
6
Age in Years

Chart X

3. Percent of Growth of Pre-School Children

On examining Table XI it will be noted that the height doubles during the first six years after birth and the weight increases four times. The greatest increase is during the first year in both height and weight. The weight-height index on an average doubles during the first six years after birth. The percent of gain is higher for boys than for girls at each age after birth and the weight-height indices are uniformly higher for boys than for girls.

Table XI

PERCENTS OF TOTAL STATURE AND WEIGHT AT SIX YEARS OF AGE

18,770 Iowa Boys and 18,188 Girls

Age	Sex	Height %	Weight %	Weight-Height Index
Birth	Boys	46.8	21.5	.076 (.42)*
	Girls	49.1	23.4	.079 (.44)
At 1 yr.	Boys	65.9	50.6	.127 (.71)
	Girls	65.6	48.3	.122 (.68)
At 2 yrs.	Boys	75.7	63.1	.138 (.77)
	Girls	76.1	61.4	.133 (.74)
At 3 yrs.	Boys	82.8	73.8	.148 (.83)
	Girls	83.4	72.0	.143 (.80)
At 4 yrs.	Boys	89.4	83.5	.155 (.87)
	Girls	89.7	80.6	.149 (.83)
At 5 yrs.	Boys	94.4	91.2	.160 (.89)
	Girls	95.8	90.2	.156 (.87)
At 6 yrs.	Boys	100.0	100.0	.166 (.93)
	Girls	100.0	100.0	.165 (.92)

* English measure

4. Individual Differences in Pre-School Children

From a clinical point of view, Table XII gives a synoptic picture of the physical measurements of nine boys and nine girls, rang-

TABLE XII

PHYSICAL MEASUREMENTS OF PRE-SCHOOL CHILDREN (IOWA CITY)

Cases	Age	Standing Height	Sitting Height	Diameter of Head: Anterior-posterior	Diameter of Head: Trans-verse	Circum-ference of Head	Width of Shoulders	Diameter of Chest: Trans-verse	Diameter of Chest: Anterior-posterior	Circum-ference of Chest	Width of Hips	Length of right: Shoulder-elbow	Length of right: Elbow-finger	Length of right: Knee-table	Length of right: Foot	Weight	Weight-height index
									BOYS								
1	4 mos.	64.5	43.0	15.7	12.4	40.9	19.9	14.2	13.3	44.4	14.3	12.6	18.7	17.7	8.4	7.94	.123(.69)*
2	8 mos.	67.5	44.3	15.2	12.4	42.2	18.0	13.7	12.8	44.5	14.0	13.6	17.8	18.4	9.5	7.39	.109(.61)
3	13 mos.	79.5	50.0	15.8	13.9	46.8	22.8	17.1	14.7	54.4	17.0	15.4	22.6	22.0	11.5	11.5	.145(.81)
4	19 mos.	83.5	49.5	16.3	14.4	48.3	24.8	18.6	15.6	54.6	18.5	18.3	23.0	24.6	11.4	13.84	.166(.93)
5	2 yrs.	90.2	51.8	16.1	14.0	49.0	21.1	16.1	13.6	50.0	16.5	18.9	21.2	26.2	14.4	13.38	.148(.83)
6	2½ yrs.	90.9	53.3	17.5	14.6	50.2	24.1	17.0	14.5	52.0	18.1	20.2	25.0	26.4	13.9	14.83	.163(.91)
7	3 yrs.	99.1	57.2	18.5	13.7	51.8	22.4	17.0	13.7	50.8	17.3	19.6	26.7	28.5	15.5	14.78	.149(.83)
8	4 yrs.	105.4	60.0	16.6	13.8	47.9	25.2	18.2	14.4	57.0	20.2	21.3	27.6	30.9	16.9	17.14	.163(.91)
9	5 yrs.	115.0	63.3	17.8	14.0	51.4	28.5	19.5	15.9	61.0	22.0	25.8	31.3	34.4	18.3	23.13	.201(1.12)
									GIRLS								
1	4 mos.	67.1	45.3	14.0	11.4	42.2	19.6	15.2	13.9	47.5	14.7	12.5	17.3	18.0	9.8	7.26	.108(.60)
2	7 mos.	67.8	44.6	15.2	11.9	42.9	18.7	13.4	13.0	45.9	14.5	12.7	19.2	17.9	10.3	8.43	.124(.69)
3	10 mos.	71.2	44.7	15.3	12.6	43.0	19.2	15.9	12.0	46.0	16.5	14.3	20.3	19.8	10.2	8.62	.121(.68)
4	19 mos.	78.0	48.6	16.4	13.5	42.2	20.8	16.6	14.3	49.0	17.2	16.3	19.6	21.8	9.5	9.76	.125(.70)
5	2 yrs.	81.3	47.2	15.7	13.1	46.0	20.8	16.5	11.7	47.0	16.8	16.0	21.6	23.4	12.2	10.6	.130(.73)
6	2½ yrs.	91.3	54.7	17.7	14.5	51.4	23.4	17.0	13.1	54.6	18.4	18.8	24.0	24.9	14.6	15.2	.166(.93)
7	3¼ yrs.	93.0	53.3	17.4	13.7	49.5	21.3	17.0	12.2	50.2	18.0	18.7	24.8	27.4	14.0	13.2	.142(.79)
8	4 yrs.	101.0	57.0	18.2	14.8	40.6	26.4	19.5	15.5	59.2	21.8	26.2	27.8	26.8	13.9	19.1	.189(1.06)
9	4¾ yrs.	101.1	53.1	18.0	16.5	50.8	24.1	17.0	12.4	52.1	18.5	20.6	26.9	30.0	15.7	15.9	.157(.88)

* English measure.

ing in ages from four months to five years. The children were nude and the measurements were carefully made at the out clinic

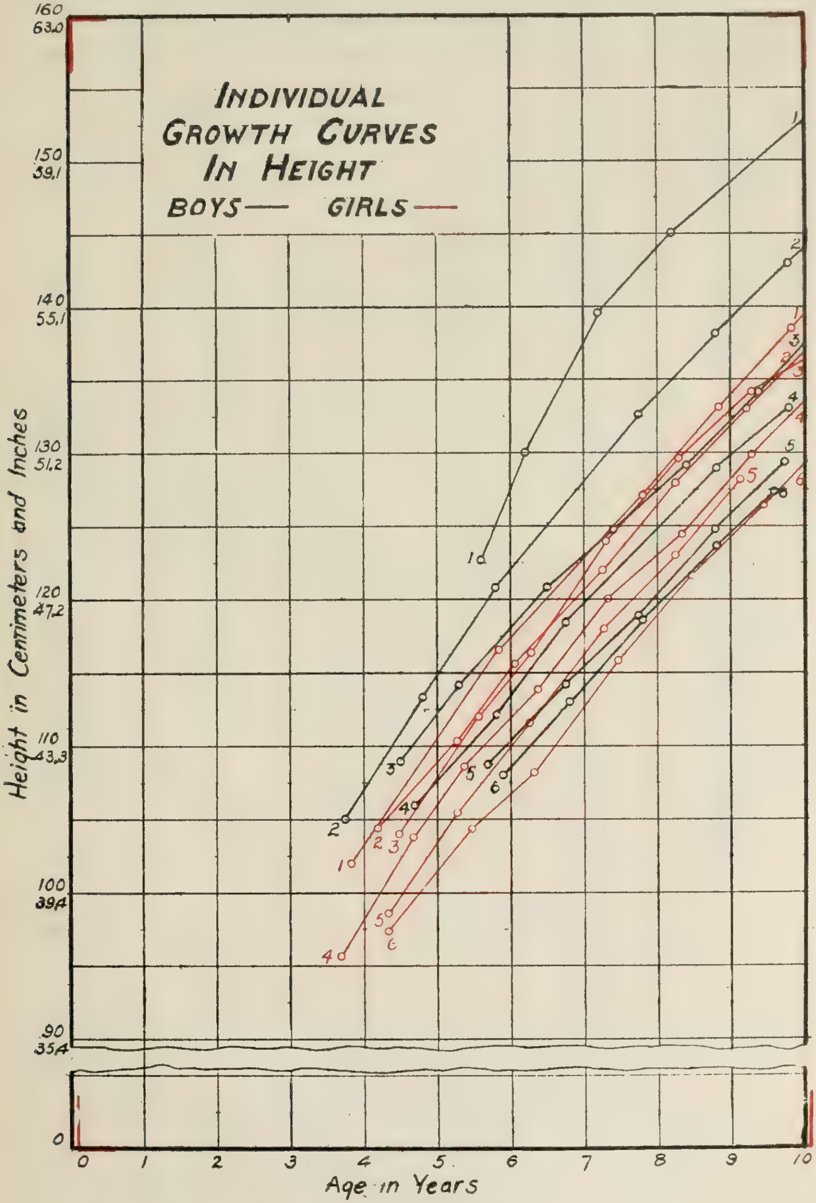


Chart XI

of the Research Station in Iowa City. A wide range of individual relationships will be noted. For example, the last girl particularly is low in sitting height, with small chest measurements when compared with the others; in head measurements the eighth boy is small; in width of shoulders, chest measurements, and width of

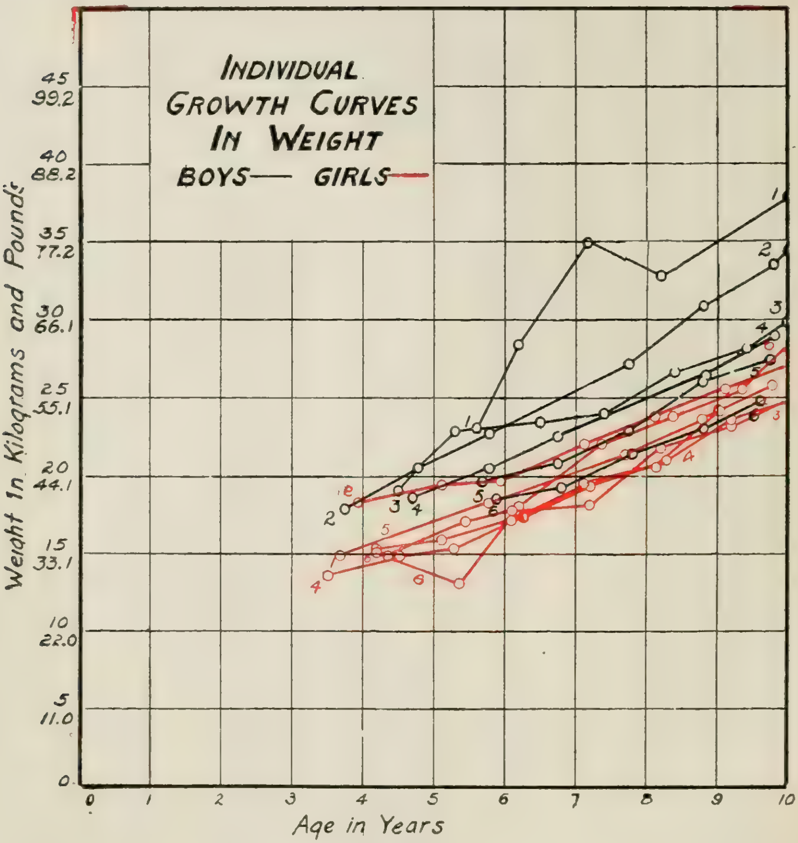


Chart XII

hips, the seventh boy and girl are comparatively small. This is also true for these two children in the other measurements and in weight.

These children were not selected as normal standards but taken at random to indicate the types of children that come to the out-clinic. Most of them had minor physical defects, but the parents were interested in getting physical ratings at regular intervals in order to improve the physical development of the children when possible.

Since few cases were recorded at birth, the averages for the first month are not very reliable but approach a good norm.

From the second month to the seventy-second month, the results are significant.

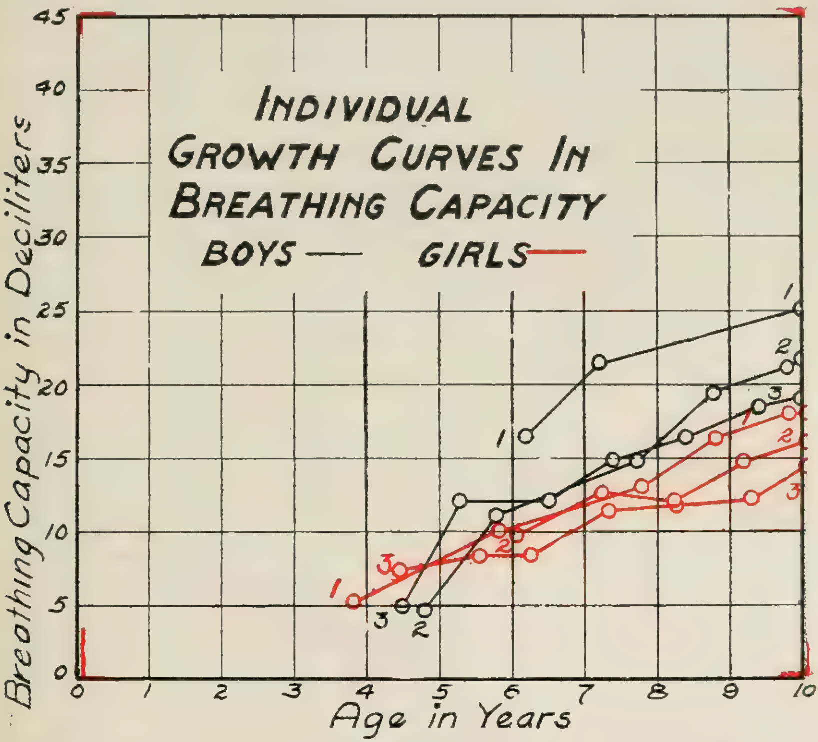


Chart XIII

5. Individual Growth Curves

These curves represent a series of repeated measurements on the same children.

6. Conclusions

I. It will be noted that the boys from birth to six years of age are uniformly taller and heavier at all ages than the girls.

II. For both boys and girls for this period the greatest increment and the greatest percent of growth is during the first year.

III. The percents of total stature and weight at six years of age show that the height doubles during the first six years after birth and the weight increases four times. The greatest increase

is during the first year in both height and weight. The weight-height index on an average, doubles during the first six years after birth.

IV. The most useful and instructive norms for these children from birth to six years of age are the weight-height indices. The indices are higher for the boys than the girls, ranging from .076

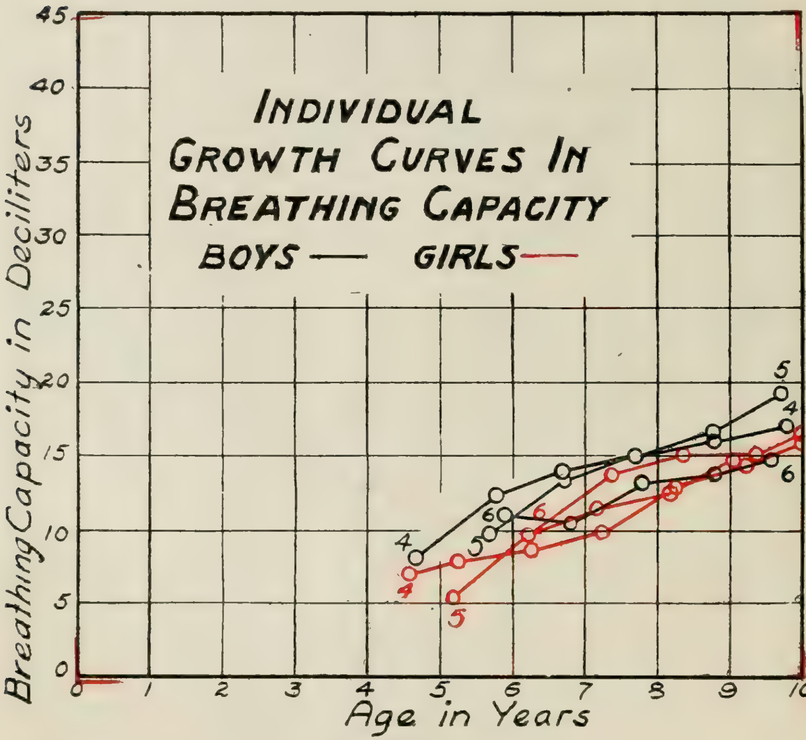


Chart XIII

and .079 respectively for the first month, to .166 and .165 for the seventy-second month. It is apparent that the boys are relatively heavier for their height than the girls.

V. The most significant conclusion for Iowa lies in the fact that these boys and girls who are above the average of the United States in height begin soon after birth to lose weight in proportion to their height. This is probably a nutritional and health education problem. This is more evident as the ages increase.

VI. Of the Iowa children included in this *Study* 82 percent are native born.

VII. "The rural Iowa children from birth to six years of age are above the urban Iowa children in stature and weight."

VIII. The type-case pictures show the wide range of individual differences in the various physical traits among supposedly normal children for periods from four months to six years of age and the need for remedial and developmental training for all.

IX. The individual growth curves for pre-school children show significant but unexplained fluctuations at five or six years of age in individual growth curves in height, weight and breathing capacity.

CHAPTER V

PHYSICAL GROWTH OF SCHOOL CHILDREN

1. Data and Methods of Tabulation

The 400 individual growth curves given in Charts XIV to XLIV are representative and may be used as typical growth histories for children between six and 17 years of age. They are new but similar in appearance to the growth curves for the 170 individuals in height, in weight and in breathing capacity published in 1914 in *Physical Growth and School Progress* (27) and include in addition to these traits individual growth records of sitting height, chest girth, strength of right and left arms and strength of upper back.

The method of selection of individuals for the height curves consisted simply of taking a few tall and a few short children in order to get a fairly wide distribution over the chart, using the same individuals for weight, breathing capacity, etc., regardless of the distribution. The Arabic numbers refer to the same individuals. For example, No. 2 in all charts refers to the same individual, the black numeral referring to a boy and the red to a girl. The boys' individual curves are printed in black and the girls' in red, in order that a direct comparison between the two may be made. All charts are accurately constructed on "No. 3297 Sphinx Cross Section millimeter paper."

It will be apparent that the direction of the curves shows the absolute increase, decrease or uniformity of the increment of growth from period to period, the ordinates indicating yearly intervals and the small circles indicating the exact date of measurement. Straight lines of uniform pitch indicate equal increments of growth for the same individual. A change in the direction of the line at any circle or point of measurement indicates an increase or decrease in the increment if the line turns towards the vertical or towards the horizontal direction, respectively. These charts, like most growth curve charts, show graphically the absolute increments of growth and not the percentage of increase or decrease over the initial measurement. Baldwin (27) p. 39.

A. INDIVIDUAL CURVES, SET 1

(1) *Height, Boys. Girls.* It will be noted from a general survey of the two groups of curves that the boys are, as a rule, taller than

the girls, except from approximately 12 to 13 years of age, on the average. The girls reach their maximum period of growth earlier than the boys. With both groups there is a tendency for the curves to fan out as the age increases. In both the boys' and girls' curves there is a slight adolescent acceleration which appears earlier for the girls than for the boys, with a slight retardation before this pubescent acceleration. For both boys and girls at the pre-adolescent period, the pubescent acceleration causes the curves to approximate in appearance a series of concentric arcs of varying sizes, where a chronological point, say 12 years, in the lower arcs, is reached later than a corresponding point in the upper arcs. The taller boys and taller girls both reach their periods of maximum growth and periods of diminution of growth earlier than do the shorter boys and girls; this is more apparent with the girls than with the boys in this particular chart. In cases where there are periods of retardation during early adolescence, this is usually followed by a period of rapid acceleration during adolescence. If the increment of growth before adolescence is relatively uniform, this uniformity tends to persist throughout adolescence, resulting in some instances in growth curves in height becoming practically a straight line.

With both boys and girls the curves assume a railroad appearance; each individual boy and girl holds approximately his or her relative position in the group for the periods from six to 17 years of age, with little crossing of the individual curves. (This explains in graphic form the high correlations found between the heights at different ages for the same individual child, p. 140) In the 1914 bulletin, it was discovered that the increment of growth in height is comparatively uniform for each individual, so that the growth curves enable one to prophesy with a high degree of accuracy how tall a child of normal growth will be in the subsequent age, providing his or her relation to a given median or norm is known. In brief, tall children do not become short; neither do short children, as a rule, become tall under normal conditions. This discovery has been verified again with these new data.

(2) *Weight, Boys. Girls.* The individual weight curves in Chart XV are for the same group of individuals whose height curves are given in Chart XIV. It will be noted that there are strikingly significant differences between the growth in weight and the growth in height. The trend of the weight curves is toward concavity

rather than toward convexity. There is more individual variation in weight and more variation in the distribution of individuals within the group, although as a general rule heavy children remain

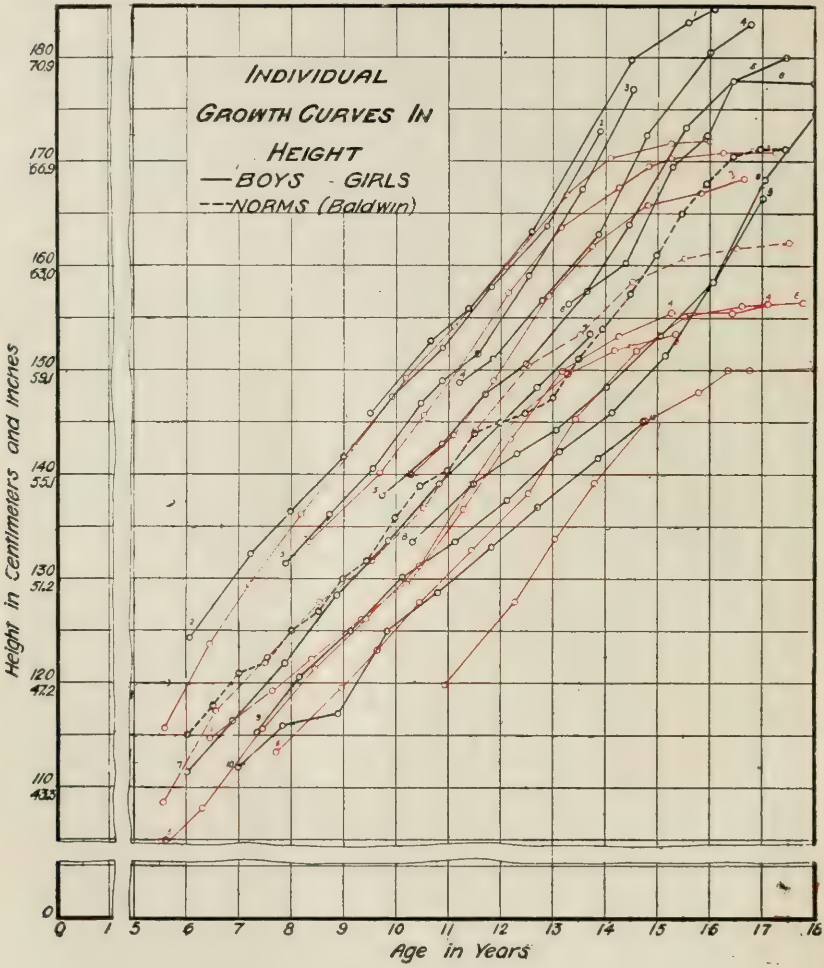


Chart XIV

relatively heavy during the period studied. Unlike height, weight may exceed or fall below the previous measurement—a fact that shows the urgent need of vigilance and the value of consecutive examinations on the part of school authorities.

Girls, as a rule, are relatively heavier for their height than boys,

and therefore the weight-height indices are higher for girls than for boys. The individual weight curves show that the pre-adolescent acceleration in weight precedes, as a rule, the acceleration in height,

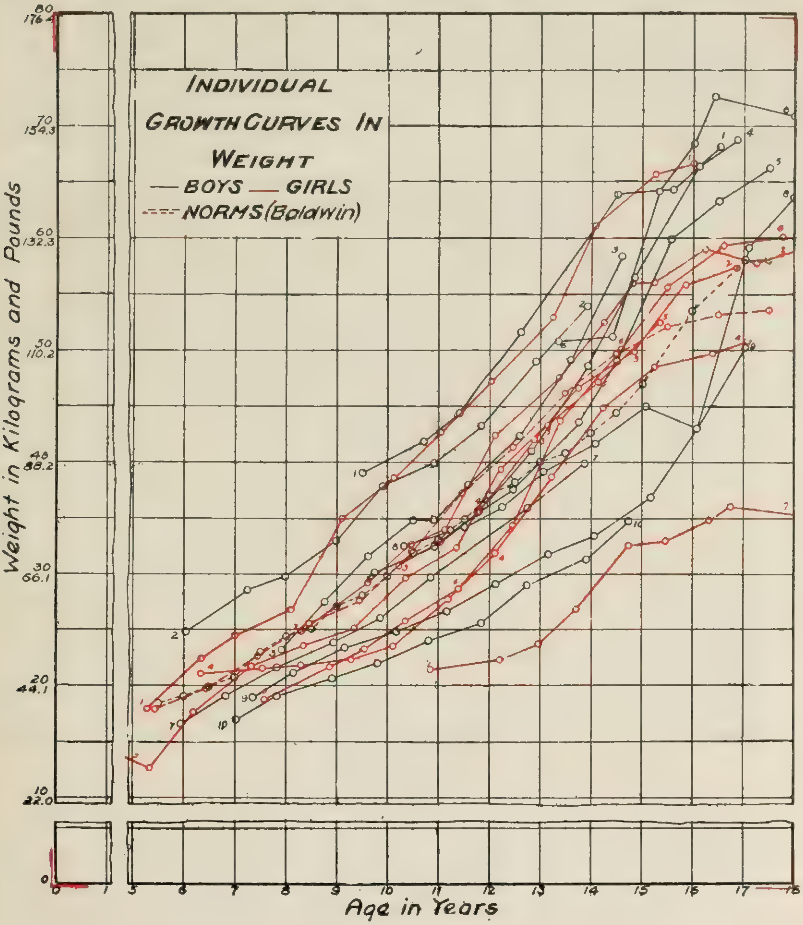


Chart XV

and that this stage in development is earlier for tall boys and tall girls.

(3) *Sitting Height, Boys. Girls.* For this group of American children it is apparent that there is a very close relationship between standing and sitting height for the same individual, since the distribution of the curves for height sitting is almost identical with the

distribution of the curves for height standing, though the relationship decreases slightly with age. The general trend of the curves is also very similar. These conditions are true, in general, for both boys and girls, but the relationship is closer for boys than for girls. The general conclusions outlined for standing height apply also to sitting height and there seem to be no marked differences between the relationship of the two for tall boys and girls and short boys

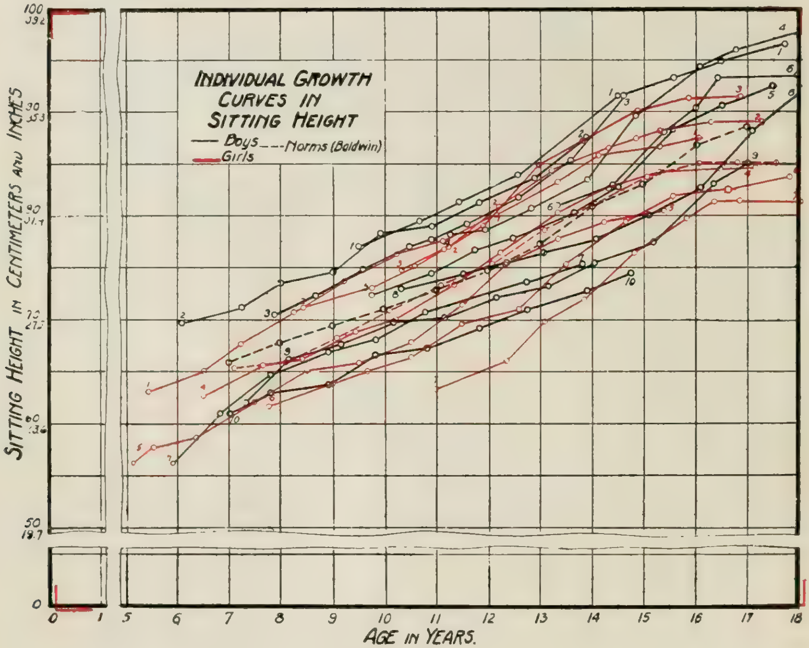


Chart XVI

and girls. There are, however, some interesting variations in the sitting height of children of the same stature, even in the same family. Sometimes the sitting height is indicative of definite racial characteristics, as for example the short trunk and long legs of the average American and the reverse condition in those of French descent. The boys and girls of tall sitting height as a rule have good or superior breathing capacity. The sitting height to the notch of the manubrium is probably a better standard for growth than the usual standing height, since the length of the neck and the size of the head are eliminated.

4. *Chest Girth, Boys. Girls.* An approximately close relation-

ship exists between the distribution of individual growth curves for chest circumference and height, but the relationship between breathing capacity and chest girth is not so close as has been generally assumed, though on the whole the general trend and positions of the two curves for each individual are similar. How far one should be taken as an equivalent of the other is an important question; the difference is more marked with girls than with boys.

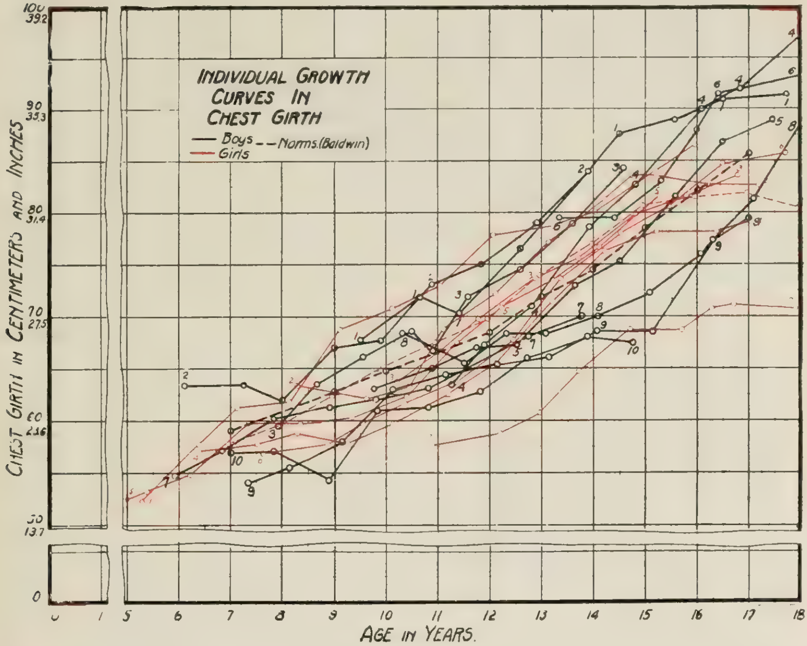
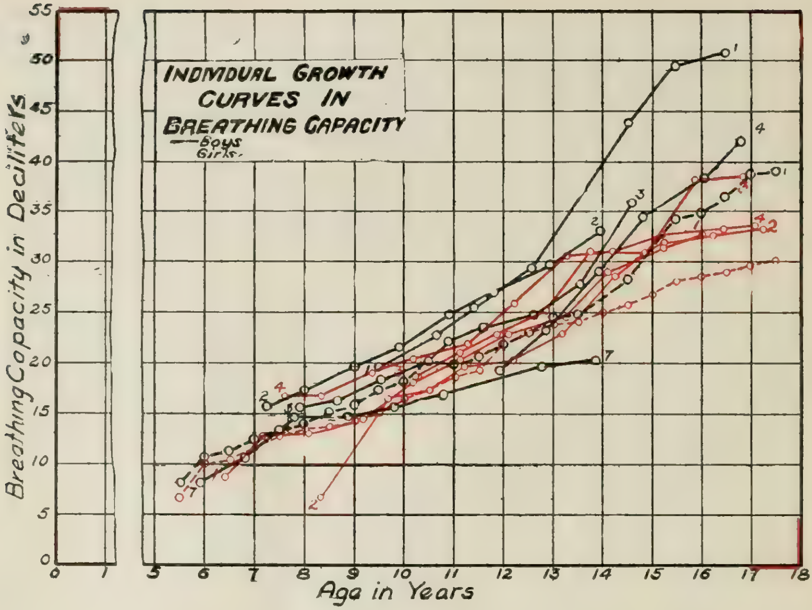


Chart XVII

Although the so-called "normal" chest girth has been selected, the chest girth is affected by breathing, the curves showing fluctuations which are probably due in part to the difficulty of making accurate measurements of the amount of residual air in the lungs or the change in subcutaneous fat or muscle.

The chest girth of girls is relatively less than that of the boys except at adolescence, and there is a cessation of development considerably earlier than in the case of the boys.

(5) *Breathing Capacity, Boys. Girls.* The individual growth curves for the 17 individuals whose height curves are given in Chart XIV and whose weight curves are given in Chart XV are distrib-


INDIVIDUAL GROWTH
CURVES IN
BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

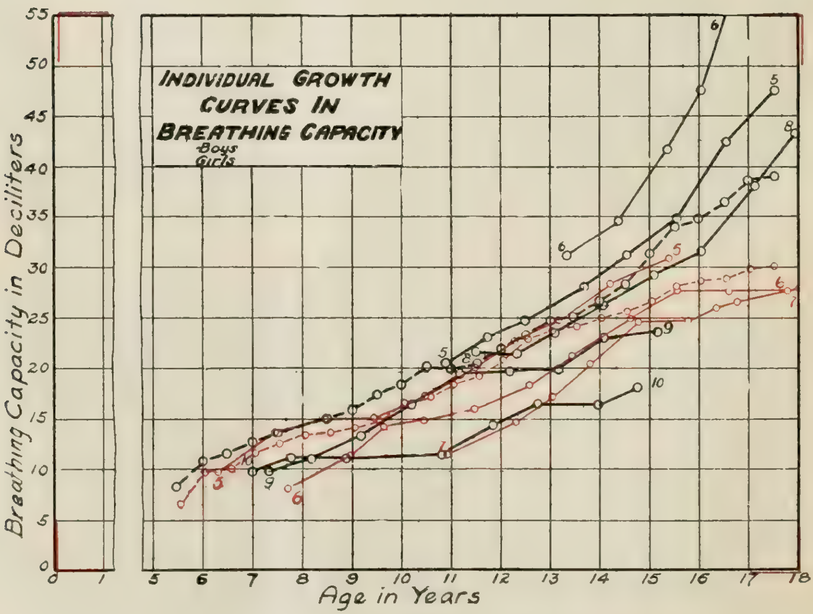

INDIVIDUAL GROWTH
CURVES IN
BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

Chart XVIII

uted in Chart XVIII which has been divided into two sections, in order to avoid the confusion of overlapping curves, since the range of distribution for individuals at a given age is less than for height and weight. These measurements and those that follow in subsequent charts for this group of individuals differ essentially from the physical anthropometric measurements for height and weight where the measurements are objective and the mental attitude and voluntary effort of the subject have little or no influence. These latter measurements involve a decided mental factor and are frequently referred to as psycho-physical measurements, the psychical factor introducing a variable difficult to standardize, especially with young children.

These curves, like those of weight, tend toward concavity. There are more individual variations than for height and in general, the larger children have greater breathing capacity than the smaller ones. As in the case of weight, these measurements may fall below previous records, and the elements of training and exercise play important parts.

The girls as a group show a smaller breathing capacity than do the boys. The girls reach their periods of cessation of growth before the boys. The boys' curves show more concavity during the preadolescent age than do those of girls, and the general shape of the curves differs. When the large number of possibilities is considered, the curves of breathing capacity show relatively little crossing.

(6) *Strength of Arms and Upper Back, Boys. Girls.* The general trend of the curves of strength of right and left forearms are plotted. They are similar to the previous strength and breathing capacity curves with similar individual distribution, overlapping and marked fluctuations in increments of improvement or regression. The relationship between strength of right and left forearms with growth in height is less than that between growth in height and any of the other traits. The girls are not so strong as the boys, and the improvement tends to decrease after fifteen years of age. The right arm is stronger, as a rule, for both boys and girls, but the difference is not so marked as has usually been assumed by writers.

The range of distribution for individuals at a given chronological age, as in breathing capacity, is close, and therefore the curves displayed for the group of boys and girls have been placed in two charts, but the Arabic numerals still refer to the same individuals.

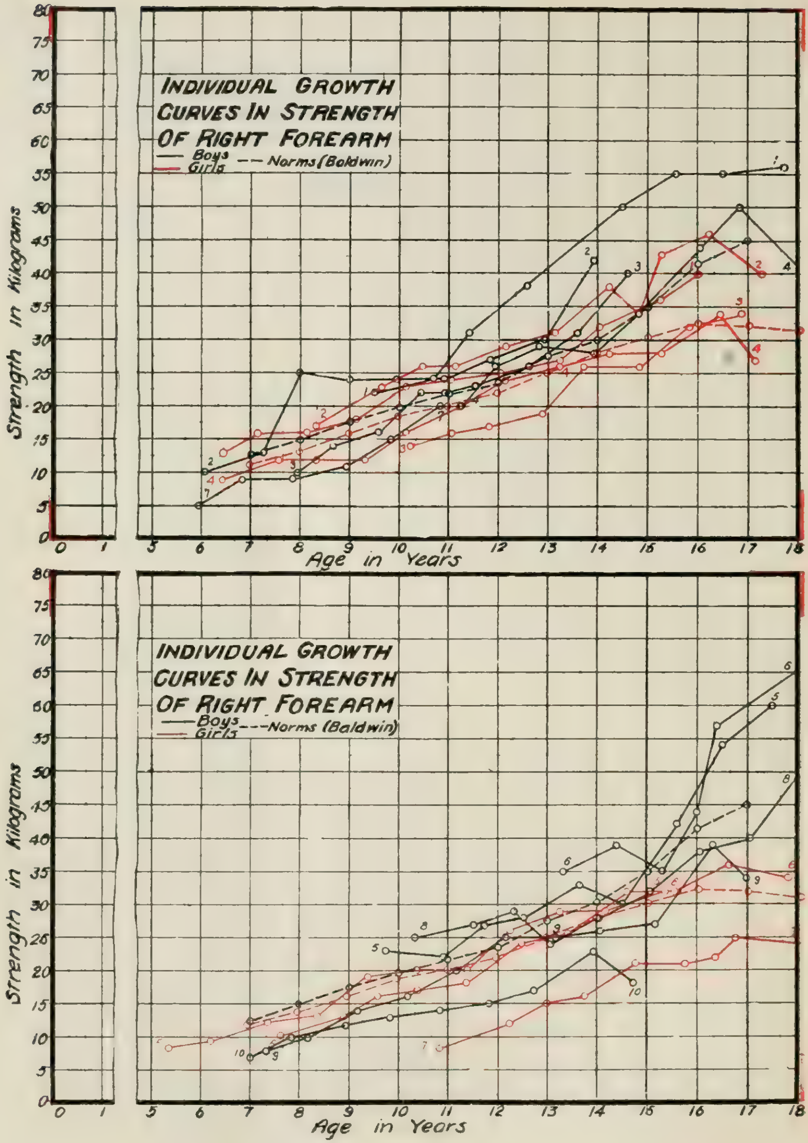
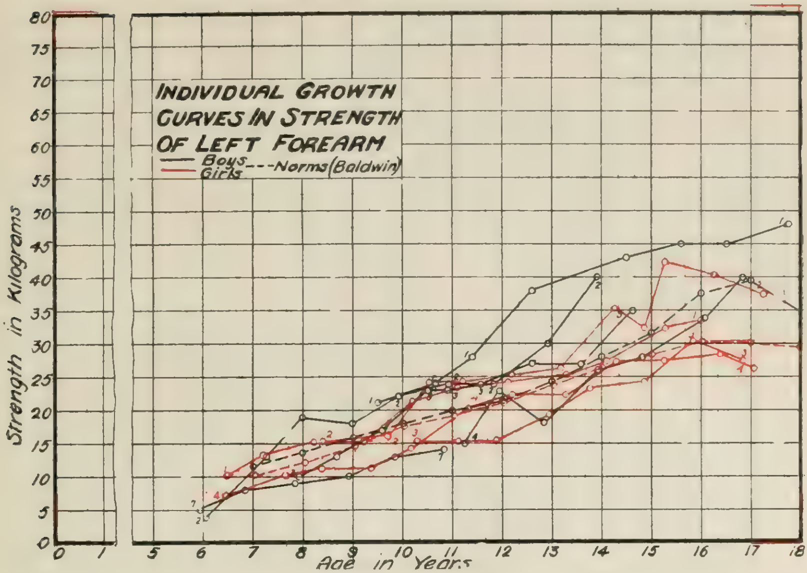


Chart XIX

As in the breathing capacity curves, the element of voluntary effort plays an important role here, and there are marked fluctuations which are, no doubt, due to this factor. In general distribu-



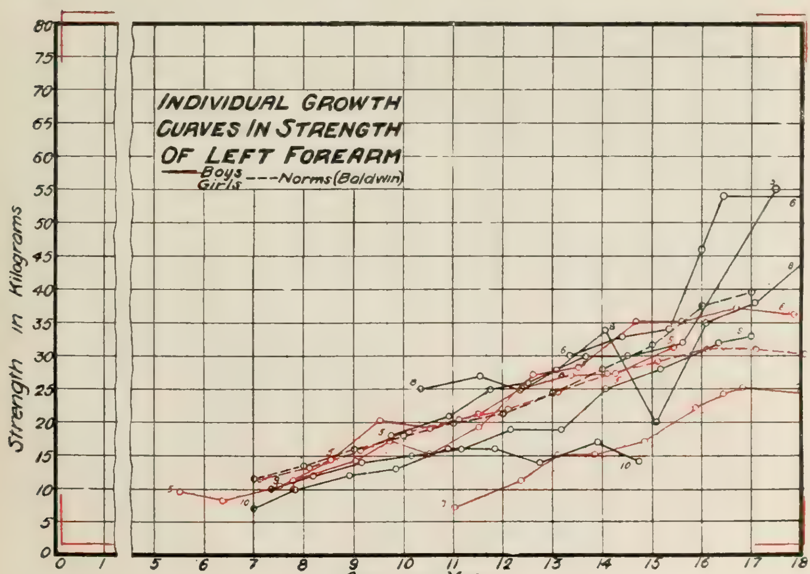


Chart XX

tion, these curves are not so closely related to those of height as in the case of the previous traits studied and consequently there is

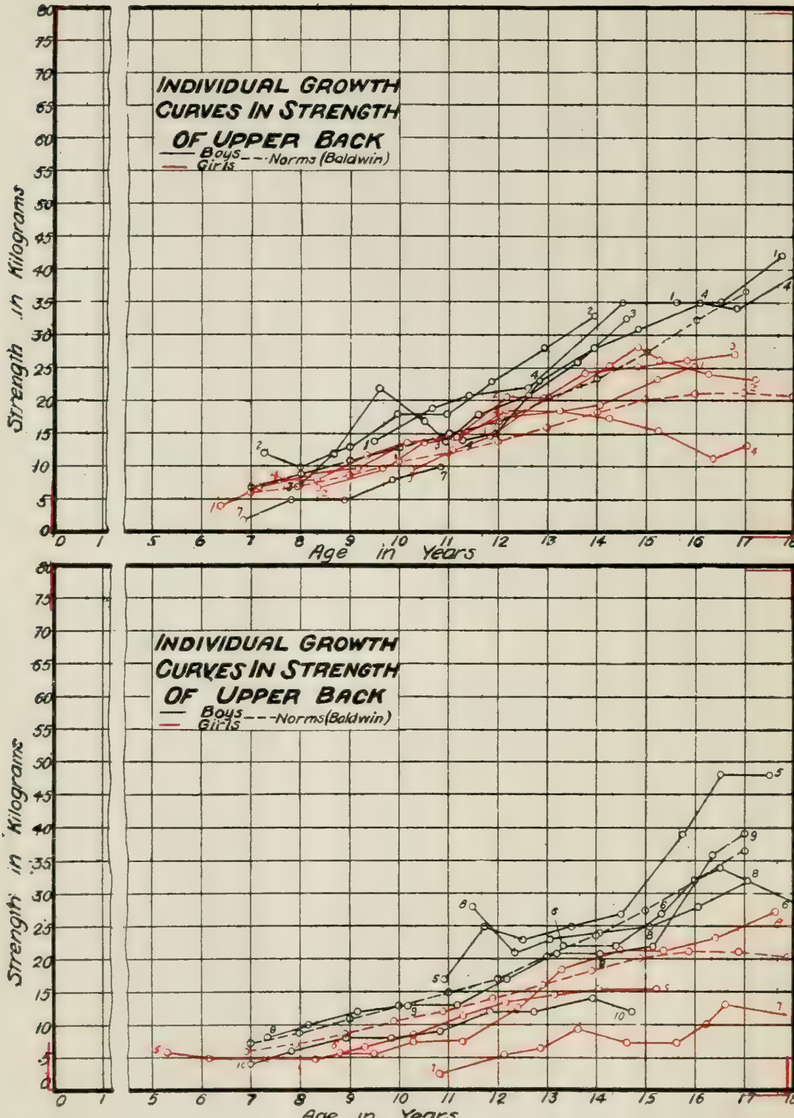


Chart XXI

more overlapping and a shifting of positions. On the whole, there is a gradual increase in the strength of the upper back from six to 18 years of age, similar to the increase in breathing capacity.

These girls are decidedly inferior to the boys in strength of the upper back, measured in kilograms. There is little increase and frequently a decrease in strength after 15 years of age for girls.

B. INDIVIDUAL CURVES, SET 2

(1) *Height.* (a) *Boys.* In this group of four boys selected at random from a group of about 200 with careful disease histories included, the first boy (*1*) shows a remarkably uniform growth curve in height from six to 17 years of age; at six he is 120 cms. tall, which is decidedly above the average of the larger group and at 17 he is 183.3 cms., which is also decidedly above the norm. No serious illness occurred, but he had weak feet and slightly enlarged tonsils from 10 to 13 years of age.

The second boy's (*2*) height curve is similar to (*1*), though he is shorter until 14 years of age, when he becomes retarded. His history is one of disease and other physical difficulties. He has had, during the school period, diphtheria twice, chicken pox, scarlet fever, tonsilitis, heart trouble, scarlet fever again, bad teeth, poor eye sight, poor posture and flat feet.

The third boy (*3*) also has a disease history of bronchitis and chicken pox, and enlarged tonsils, but these apparently affect growth in height but little. His poor posture during early school life was corrected somewhat during the later period as indicated by his health history. The latter period shows a regaining of the earlier relative position in height.

The fourth boy (*4*) was relatively small in stature at eight years of age and still much smaller relatively at 18 years of age. He had measles and chicken pox, and was also a mouth breather early in his school life. The nasal obstruction, enlarged tonsils and adenoids were not removed as advised, prior to twelve years of age. He had bad posture and poor eyesight, wearing glasses after 13 years of age. He is not so tall at 18 as his early height curve would lead one to expect. His growth has been stunted in height and it will be interesting to see how he measures up in other traits.

(b). *Girls.* The four girls in this group show more irregularity in growth in height than do the boys, particularly at a later age in the case of No. (*1*) and No. (*4*). No. (*1*) is a relatively tall girl until 13, but grows little after this age and very little after 14. She has had eye trouble, slightly enlarged tonsils, heart murmurs, and poor posture. She matured before 13 years of age.

No. (2) had slightly enlarged tonsils, a little heart trouble and was slightly nervous. Her growth curve is typical of good growth; she matured between 13 and 14 years of age. No. (3) had medium nutrition, but had adenoids removed at 14 years of age and also had

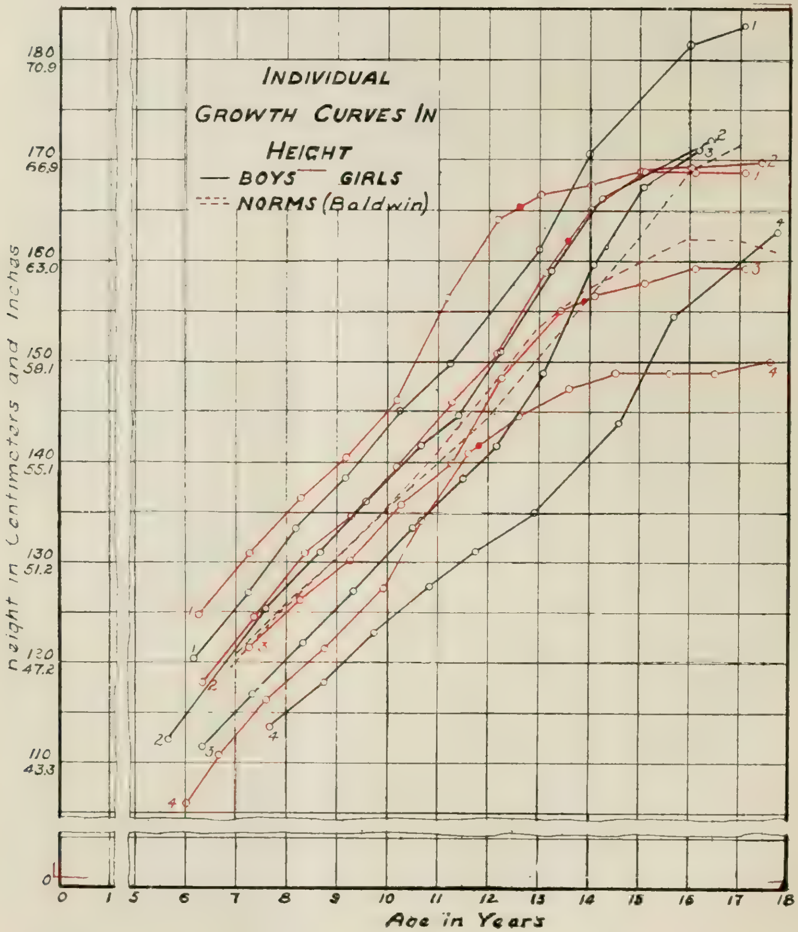


Chart XXII

a mastoid at this age. She matured during the same period. No. (4) had the usual children's diseases and enlarged tonsils which were not removed. The time of maturation was remarkably early for such a short girl, before 12 years, and cessation in growth began shortly after 12. A weak back is indicated.

(2) *Weight.* (a). *Boys.* The weight curves for these four boys are somewhat different from what would ordinarily be expected. The weight curve of No. (*1*) is very regular and uniform, but (*2*) and (*3*) are both superior to (*1*) at 16 years of age in spite of (*1*)'s

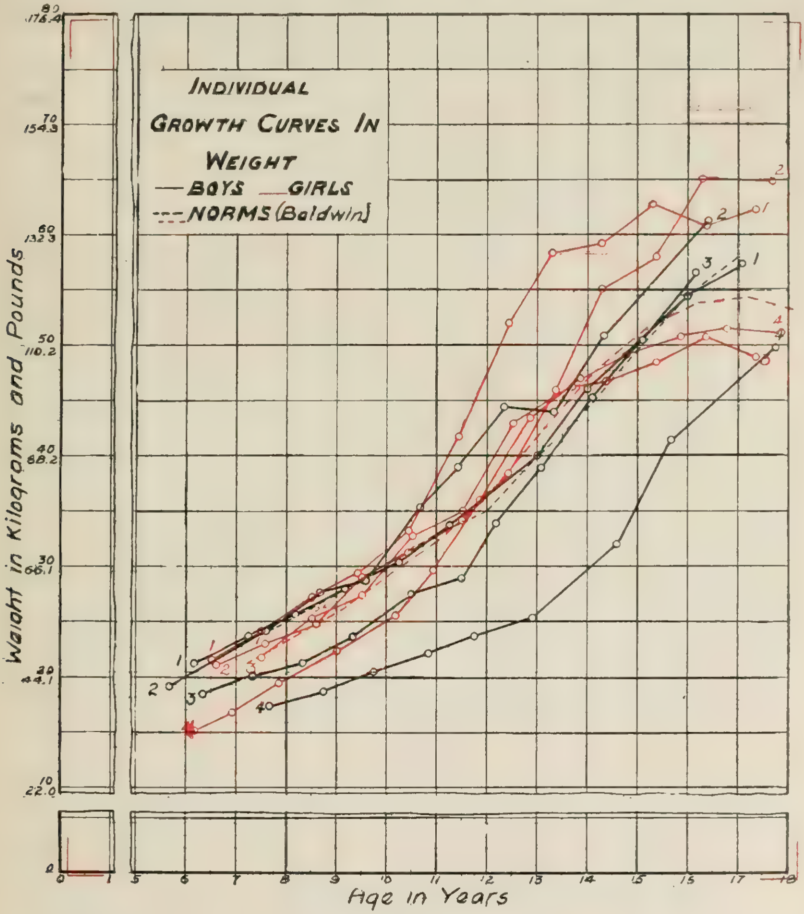


Chart XXIII

superior height. He is a tall, thin boy, weighing less than 60 kgs. at 17 years of age.

No. (*2*), regardless of his serious diseases, which gave him temporary setbacks, is a fairly heavy boy. No. (*3*), after his early illness with bronchitis and chicken pox, gained rapidly and consist-

ently after 11 years of age and excels No. (*1*) at 16. No. (*4*)'s weight curve, like his height curve, shows defective growth.

(b). *Girls.* In weight the growth curves are similar to those of height. (*1*) failed to gain after 13 as she should; (*2*) was more nearly normal in development; (*3*) lost in weight relatively after 13; and (*4*) had the same experience after 12 years of age.

(3) *Sitting Height.* (a) *Boys.* For height sitting, little need be

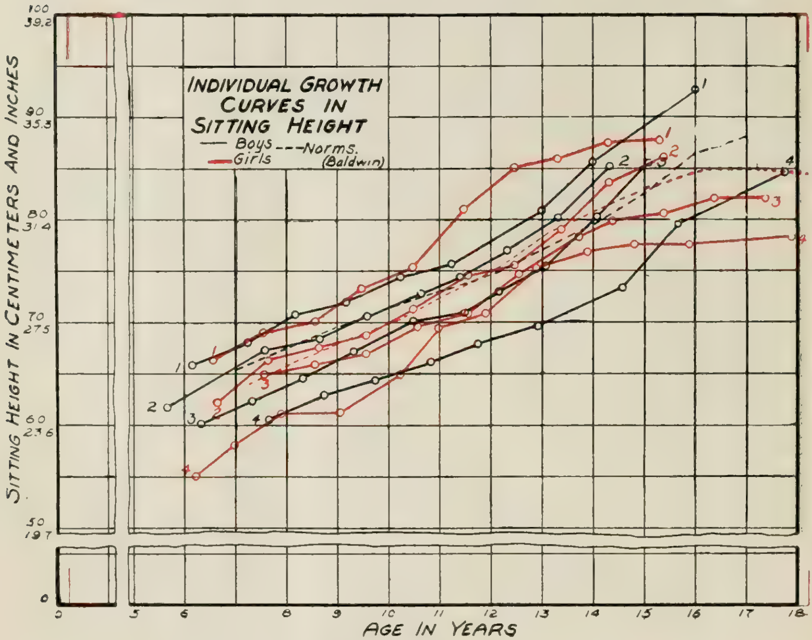


Chart XXIV

stated here, since the curves are so similar to those for height standing, but it should be noted that the same retardation is apparent for (*4*) as in height standing.

(b). *Girls.* In sitting height (*1*)'s records are incomplete after 15, but the trend until this time is similar to that in standing height, as is also the case with (*2*); both grow proportionately about the same in sitting height, *i. e.* the course of the curves is parallel. (*3*)'s curve trend is about the same as in height standing, and (*4*) fluctuates a little more, but ends in about the same position.

(4) *Chest Girth.* (a) *Boys.* In chest girth the thin, undeveloped nature of No. (*1*) is more apparent than in weight. No. (*2*)'s

robustness is shown by the ascending curve and No. (*3*) gains rapidly after 11½ years of age. No. (*4*) is still the smaller and relatively the inferior child.

(b). *Girls.* In development in girth of chest the story is different. All fluctuate considerably. (*3*) is inferior after 12 years of age; (*4*) exceeds (*1*) and equals (*2*) at 17½ years of age. It is apparent that there are other factors involved here than development of

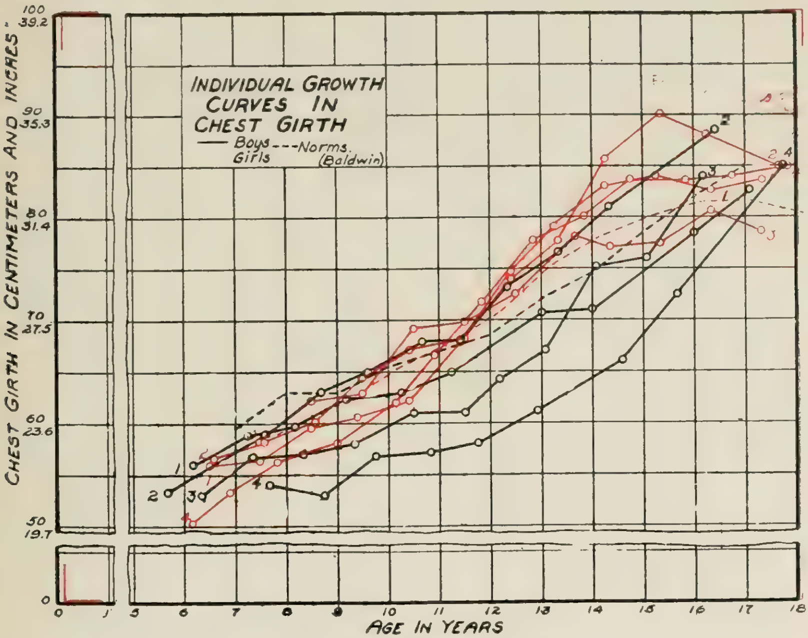


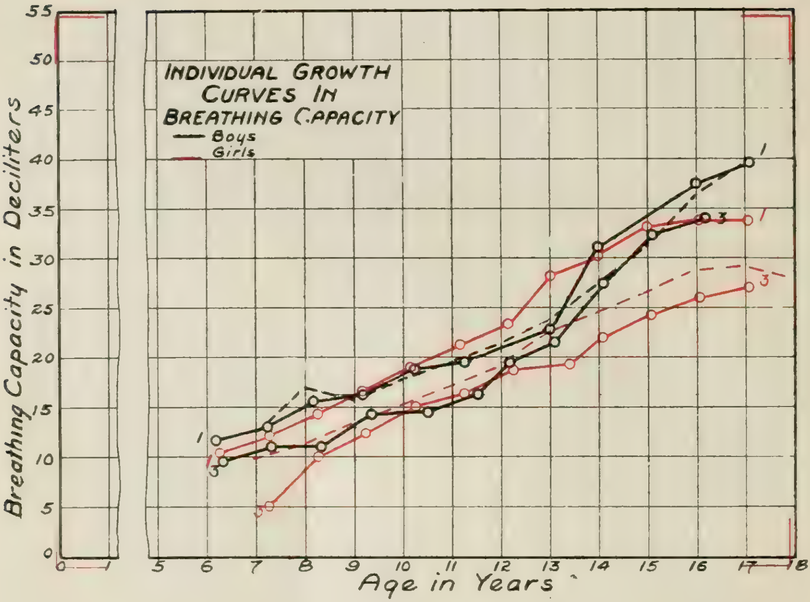
Chart XXV

breathing capacity; the early maturing of (*4*) is apparently one of these factors.

(5) *Breathing Capacity.* (a) *Boys.* In breathing capacity the boys have the same relative positions they had in height (*1*), (*2*), (*3*), (*4*), with individual fluctuations.

(b). *Girls.* The girls vary more individually in relative position, (*2*) and (*4*) having superior breathing capacity.

(6) *Strength of Arms and Upper Back.* (a) *Boys.* In strength of right forearm (*2*) still holds supremacy. He is strong, but relatively weak when his height is taken into consideration. No. (*3*) shows relative gains after 11½ years of age. The fourth boy


INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

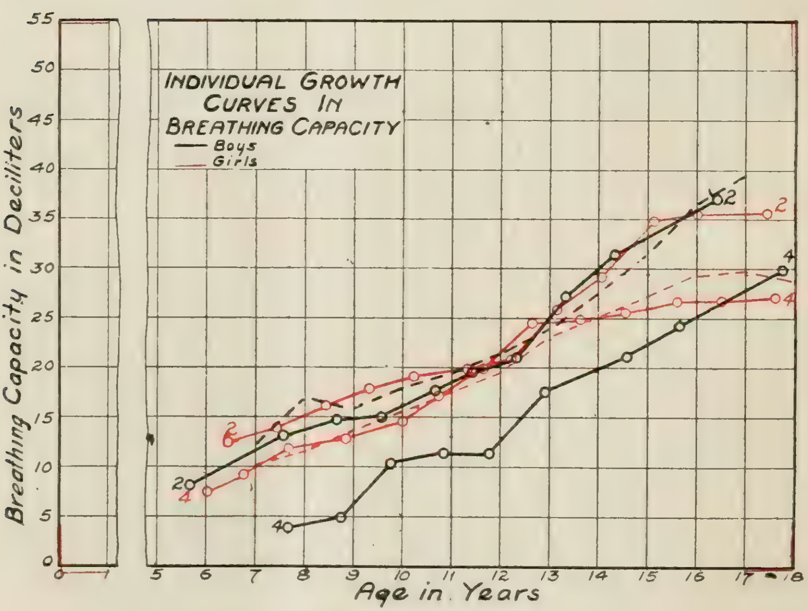

INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

Chart XXVI

(*4*) does not gain in strength as he should, when measured by a a norm, but the retarded growth in his other traits previously shown makes a further explanation unnecessary here.

No. (*1*) shows decided inferiority in strength of the left forearm.

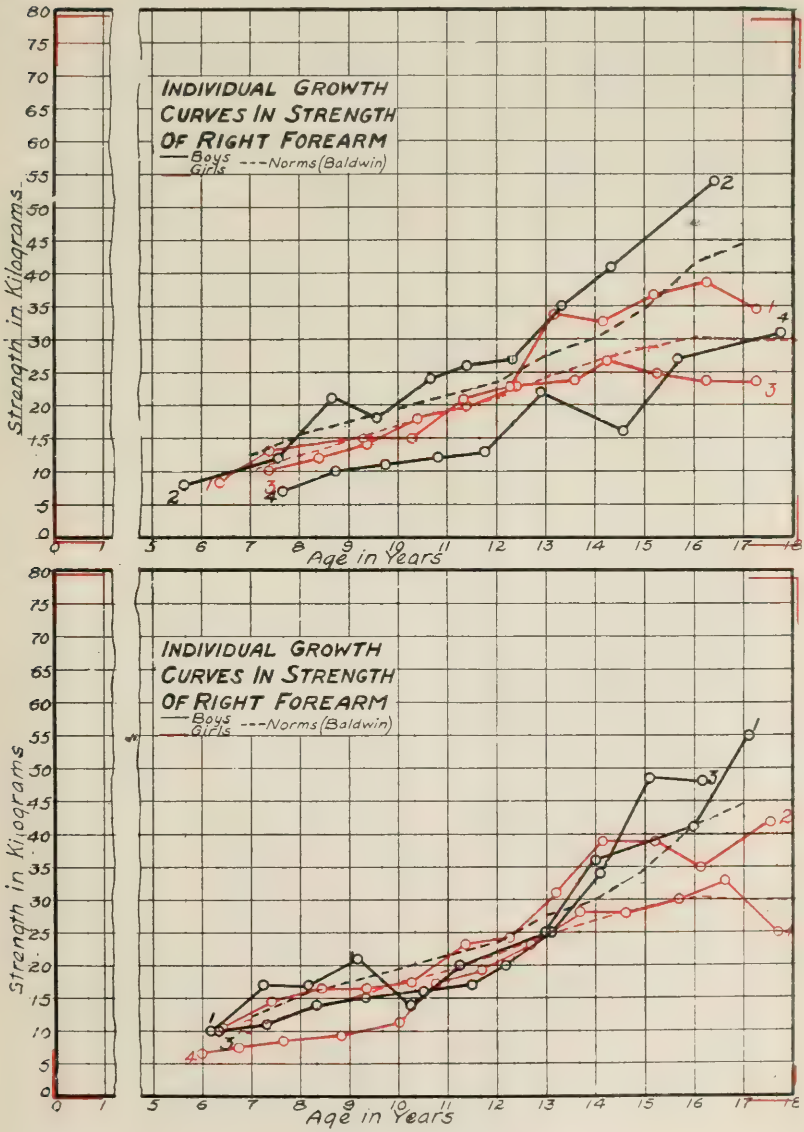
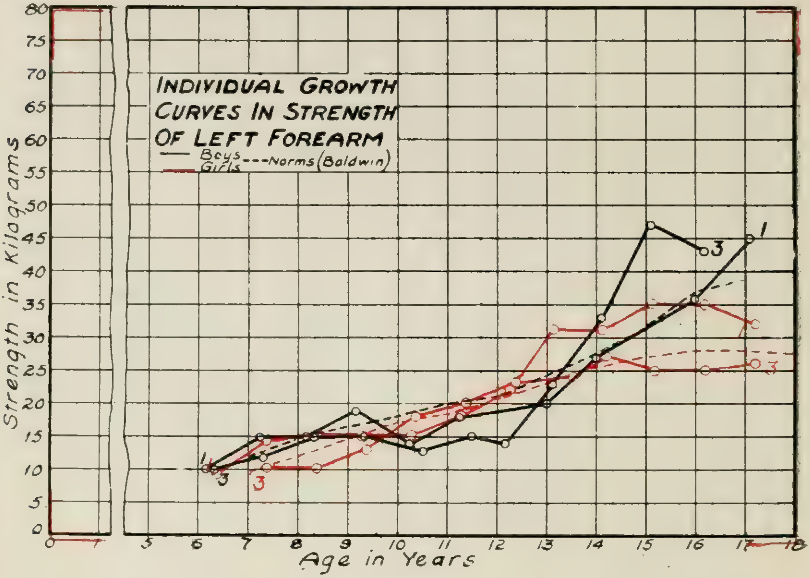


Chart XXVII

compared to that of the right. No. (*2*) is equally strong in both. No. (*3*) shows a similar equality, and No. (*4*) has about the same



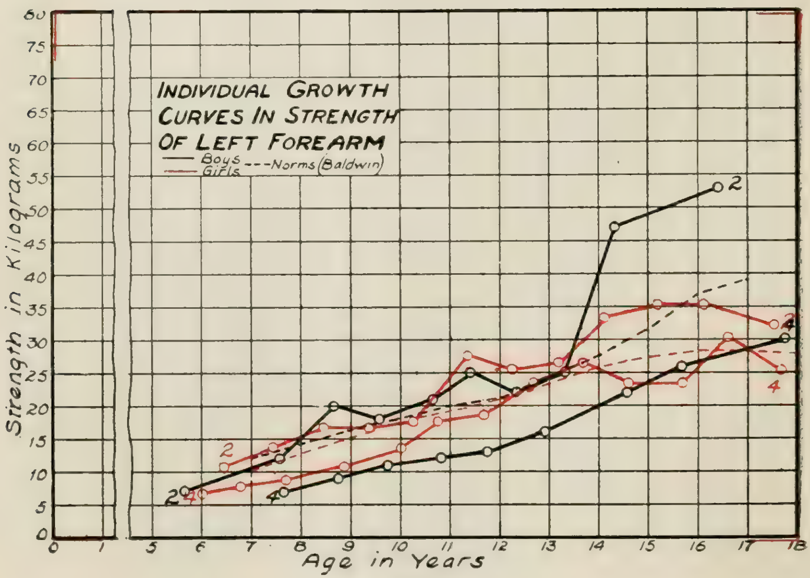
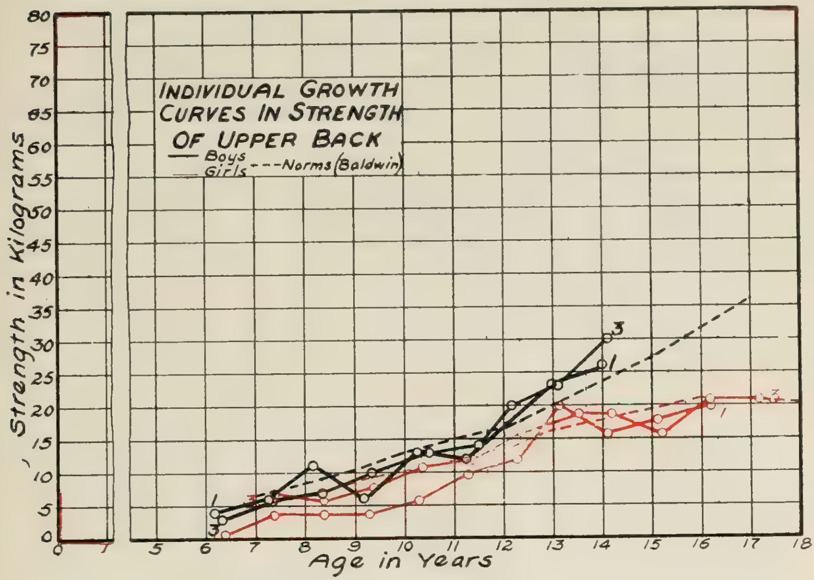


Chart XXVIII

strength in both forearms, though the records for the right arm show a little more fluctuation.

The curves for strength of the upper back show that No. (*1*)



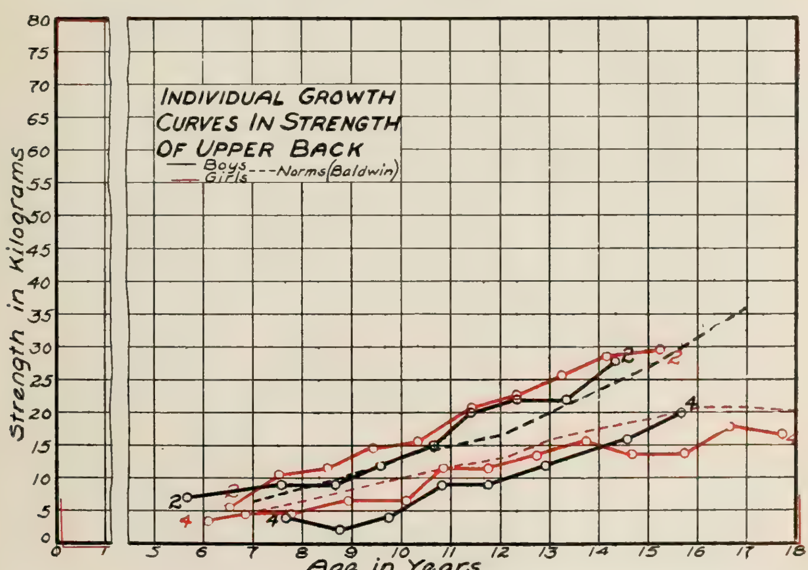


Chart XXIX

is relatively weak, with much fluctuation in performance; No. (*2*) is steady in development but not so strong as his weight would indicate; No. (*3*) is fairly uniform in growth, as his other traits show; and (*4*) shows a steady tendency not to make adequate gains in strength, his record being even less than his smaller stature would lead one to expect.

(b). *Girls.* In the strength series (*3*) and (*4*) are inferior to (*1*) and (*2*), and (*1*) slightly inferior to (*2*), for the right forearm. A similar distribution holds true for the left forearm. In strength of upper back (*2*) shows a steady good growth, (*1*) improves but does not exceed (*3*), and (*4*) shows relatively little growth during the twelve years of school life.

Conclusions (Set 1 and Set 2)

1. HEIGHT

I. For boys and girls from six to 18 years of age there is a slight adolescent acceleration in height, sitting height, weight, breathing capacity and the strength traits which appears earlier for girls than for boys and earlier for tall girls or boys than for those below the norms.

II. A series of individual growth curves of varying heights approximates in form a series of concentric arcs of varying sizes where a chronological point in the lower arcs is reached later than a corresponding point in the upper arcs.

III. As a rule tall boys and tall girls reach their periods of maximum adolescent stature earlier than do short ones.

IV. If the increments of growth in stature before adolescence are relatively uniform (*i. e.* represented by a straight line on the charts) this uniformity of increase tends to persist throughout adolescence. If there is retardation before adolescence the tendency is to show a rapid acceleration during adolescence, as a compensating factor.

V. With boys and girls the stature curves show a railroad appearance with relatively little crossing but a tendency to fan out at adolescence.

VI. Tall children at any age remain relatively tall under normal conditions. Growth in height is so comparatively uniform for each individual that the growth curve enables one to prophesy with a high degree of accuracy how tall a young child will be at subsequent years.

VII. Growth in height is affected by the formation and removal of adenoids.

VIII. Prolonged disease history retards normal growth in stature.

2. WEIGHT

I. Growth curves in weight from seven to 17 years of age tend toward concavity; those in height toward convexity.

II. There is more individual variation in growth in weight than in growth in height.

III. Pre-adolescent acceleration in growth of weight precedes as a rule the pre-adolescent acceleration in growth in height.

IV. The pre-adolescent acceleration in growth in weight is earlier, chronologically, for the tall boys or girls than for the short ones.

V. Growth in weight is affected by disease history and the growth and removal of adenoids.

3. SITTING HEIGHT

I. The trend and distribution of individual curves in sitting height are almost identical with the trend and distribution of the standing height curves for boys and for girls, more particularly for boys.

II. The conclusions outlined on page 92 for individual growth in stature apply in general for individual growth in sitting height.

III. Growth in sitting height is affected by disease and adenoids, as in the case of standing height.

IV. Sitting height standards are more satisfactory from an anthropometric point of view than those for standing height.

4. CHEST GIRTH

I. Chest girth for girls is relatively less than for boys during the pre-adolescent period.

II. Cessation in growth of chest girth occurs earlier for girls than for boys.

III. Development of chest girth does not parallel growth in stature, as do the other traits previously mentioned.

5. BREATHING CAPACITY

I. Measurements of growth in breathing capacity involve a *mental factor* which differentiates this measurement from those of height, weight, sitting height and chest girth.

II. Individual breathing capacity curves, like those for weight, tend

toward concavity, which is more marked in the boys' curves than in the girls'.

III. There are marked individual variations in the breathing capacity curves.

IV. Larger and taller children as a rule have greater breathing capacity than smaller ones.

V. Girls show inferior development in breathing capacity to boys.

VI. Girls reach their periods of cessation of growth before boys.

VII. Taller, heavier boys and girls as a rule have their accelerated periods of growth in breathing capacity at an earlier period than do those below the norms in height and weight.

VIII. Retarded development in stature and weight is paralleled by retarded development in breathing capacity.

6. STRENGTH OF ARMS AND UPPER BACK

I. Individual strength curves for arms and upper back are similar in irregularity to the breathing capacity curves.

II. As in the breathing capacity curves, the element of voluntary effort plays an important rôle in evaluating the development of strength.

III. Girls are inferior to boys in all strength tests, girls showing, after 15 years of age, little increase, and frequently a decrease in strength.

IV. The right arm as a rule for both boys and girls is stronger than the left, but the difference is not so marked as has usually been assumed.

V. In the distribution of strength curves, there is more overlapping, with marked fluctuations in increments of improvement or regression in individual strength curves than in the case in curves of height, weight, breathing capacity, sitting height and chest girth.

VI. The observed correlation between individual stature and strength curves is not so evident as in the other traits previously outlined.

VII. Development in strength of right arm, left arm and upper back is materially affected by prolonged disease history.

C. INDIVIDUAL CURVES, BROTHERS AND SISTERS, SET 3.

(1) *Height* (a). *Brothers.* In this series of Charts XXX to XXXVII two sets of brothers—(*1*) and (*2*), and (*3*) and (4) are

given for comparison, and two sets of sisters (*1*) and (*2*), and (*3*) and (*4*). It will be noted in the case of the boys that the taller boy (*1*), who is the younger brother, is 7.7 cm. taller at 16 years of age. In accordance with the laws of growth previously stated, p. 92 the taller brother (*1*) reaches the period of accelerated growth earlier—11 years, 2 months—and the shorter (*2*), later—11 years 9 months. The taller (*1*) also reaches the period of diminishing increments earlier—13 years, 10 months—and the smaller (*2*) later—14 years, 9 months. The widest range of difference is at 11 years, 9 months, when the taller (*1*) has started his adolescent acceleration and the shorter (*2*) is in the period of pre-adolescent cessation of growth, the difference being 12 cm.

If the curves of growth are thought of as parallel or concentric curves which give an index of physiological stages of growth, it will be noted that at the chronological age of seven years for the taller boy (*1*) and seven years nine months for the shorter boy (*2*), the actual difference in height is 2½ cm.; at eight years for the taller (*1*) and eight years eight months for the shorter (*2*) the difference is 3 cm.; at nine years for the taller (*1*) and nine years 11 months for the shorter (*2*) the difference is 4 cm. At 12 years for the taller (*1*) and 13 years 3 months for the shorter (*2*), the difference in height is 3.8 cm. The growth of these two brothers is strikingly similar and the curves are typical of the normal standard growth curves. In chronological age the taller boy (*1*) is four years in advance of the other (*2*).

The other two brothers, (*3*) and (*4*), differ relatively in height about the same as (*1*) and (*2*), but both are shorter. They differ chronologically seven years, the taller boy (*3*) being the younger. The trend of the curve of the shorter boy (*4*) shows that he is physiologically younger at a given chronological age than (*1*) or (*2*).

(b). *Sisters.* For the two pairs of sisters the uniformity of growth in height is almost as regular as for the four boys, although both sets of sisters manifested more ill health and a longer disease history. The tallest girl and her shorter sister differ greatly in height, but the difference is constant. The removal of adenoids at 12 had little apparent effect on growth in stature for (*1*); (*2*) shows a retardation in growth in height after 13½ years, when the health notes state she was "nervous" and had had enlarged tonsils. No.

(*1*) matured at 14 years 5 months of age, and No. (*2*) at 14 years 6 months. No. (*2*) is the older sister, chronologically.

The other two sisters whose growth curves are shown in the charts are very nearly the same height; the shorter one (*4*) is just

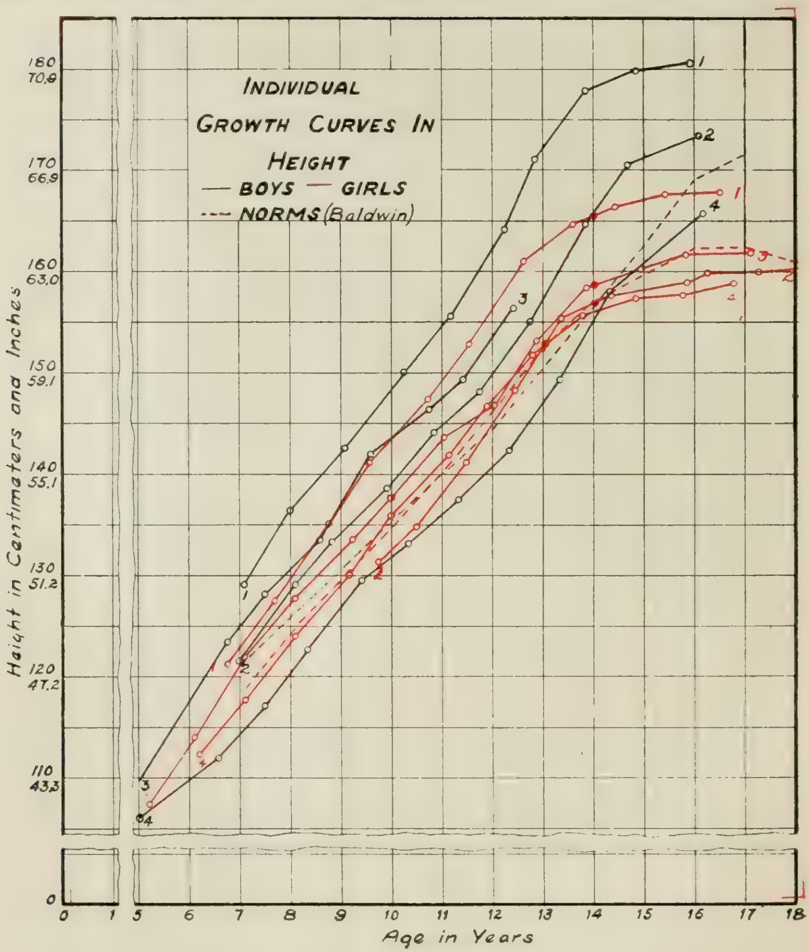


Chart XXX

one year older chronologically than (*3*). The former (*3*) was anaemic at 9 years of age, had poor circulation and later developed round shoulders and had slightly enlarged tonsils; the latter (*4*) had her tonsils removed at 12½ years of age; her health in general was better than her sister's (*3*).

(2) *Weight.* (a). *Brothers.* The weight curves for the two sets of brothers are in accord with the general results for height; the two taller boys are also the two heavier during the interval from five or seven to 17 years of age, assuming that (*3*) continues to

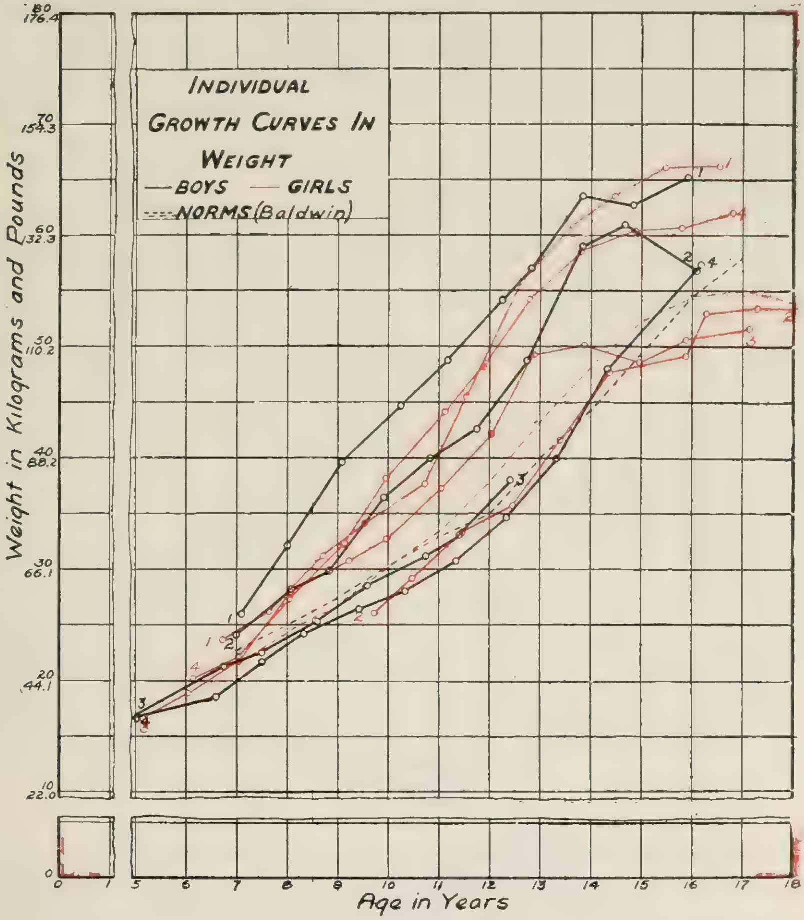


Chart XXXI

grow as he has in the past. No. (*2*) was apparently ill at 16 years of age, but the exact nature of the illness is not recorded. The healthy robustness of these four boys is evident in the weight curves.

(b). *Sisters.* For the girls the same signs of irregular development are present that were found for growth in height. No. (*1*) lost weight before the removal of adenoids at 12 years of age, but

rapidly regained her superior position again after the operation. Her sister (*2*) shows a decline in weight after 14 years of age. For (*3*) and (*4*) it may be noted that (*4*)'s development is fairly regular, but (*3*) loses weight markedly after 13 years of age, and for the remainder of her school life the weight history is a discouraging one. The former (*3*) matured between 13 and 14 years of age, the latter (*4*) at about 13 years of age. Whether the drop in the curve of growth in height for (*3*) is due to the anaemia, the round

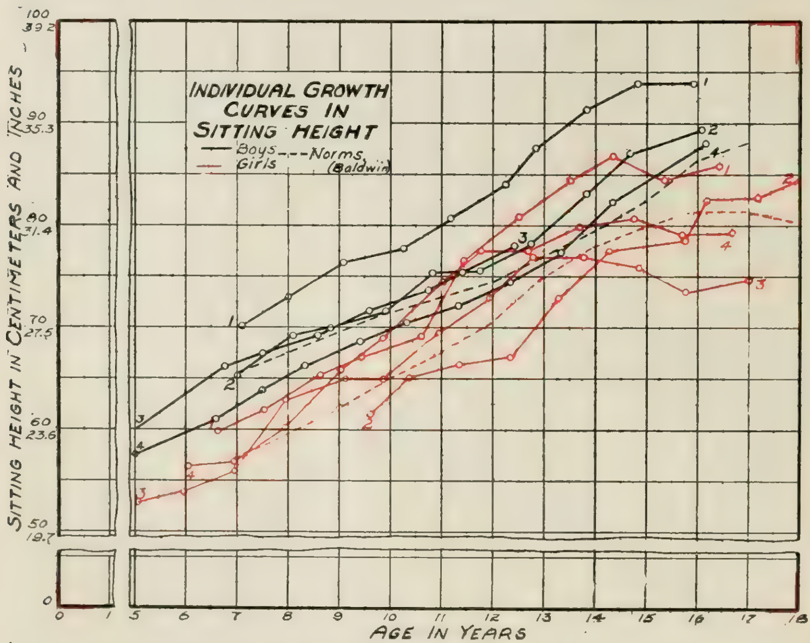


Chart XXXII

shoulders, the enlarged tonsils or the slightly delayed maturity is not clear, but the curve illustrates the growth principle previously formulated that if growth in height is retarded for a short time, there is an additional increase subsequently and the normal relative position is attained.

(3) *Sitting Height.* (a). *Brothers.* In sitting height the general course of development of the brothers (*1*) and (*2*) is the same as in the standing height, the taller having the advantage; the other brothers (*3*) and (*4*) also hold their relative positions as in height. Children of the same family may differ in the proportion of height

sitting to height standing and this would explain the overlapping of curves (*2*) and (*3*), which does not occur in the height curves.

(b). *Sisters.* For sitting height sisters (*1*) and (*2*) hold approximately their same relative positions as in height, the distance between the curves remaining about the same during the growth period, although (*2*) varies a little more than (*1*). The other girls show the same likeness to each other in relative height sitting as standing at the beginning, but (*3*) having lost her relative height

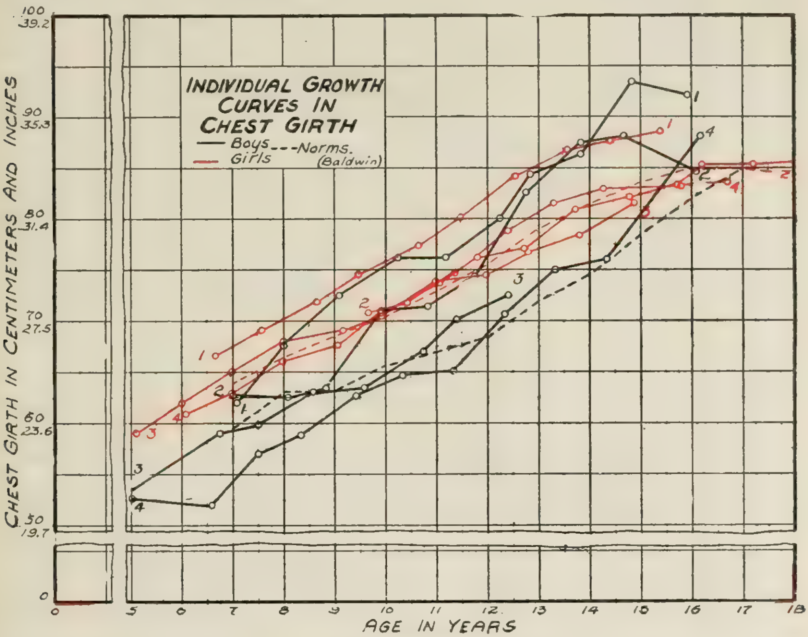
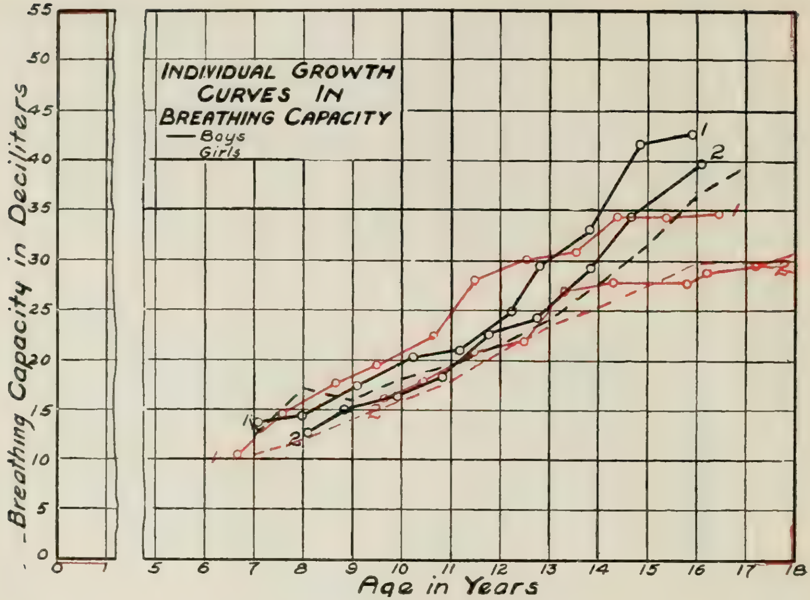


Chart XXXIII

sitting position with reference to (*4*), does not regain it. Is this due to round shoulders, weakness or posture? The other sisters also show, at the beginning, a parallel course of the curves for sitting height, just as for standing height. After a few years, however, (*3*) with a taller sitting height does not continue to grow at the same rate; her curve drops down nearer to the level of (*4*)'s and never rises again to the height it might have attained if growth had been uninterrupted. The cause of the interruption is not clear, but posture, round shoulders or weakness might furnish an explanation.


INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

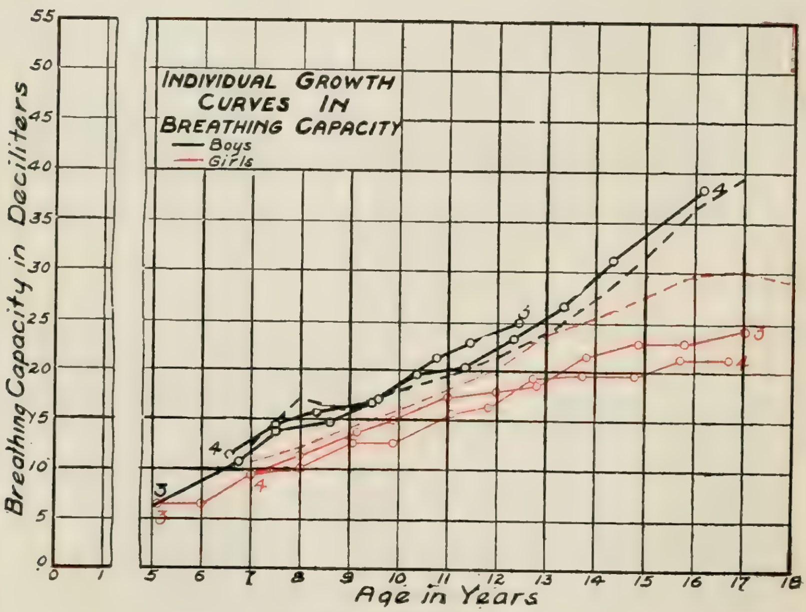
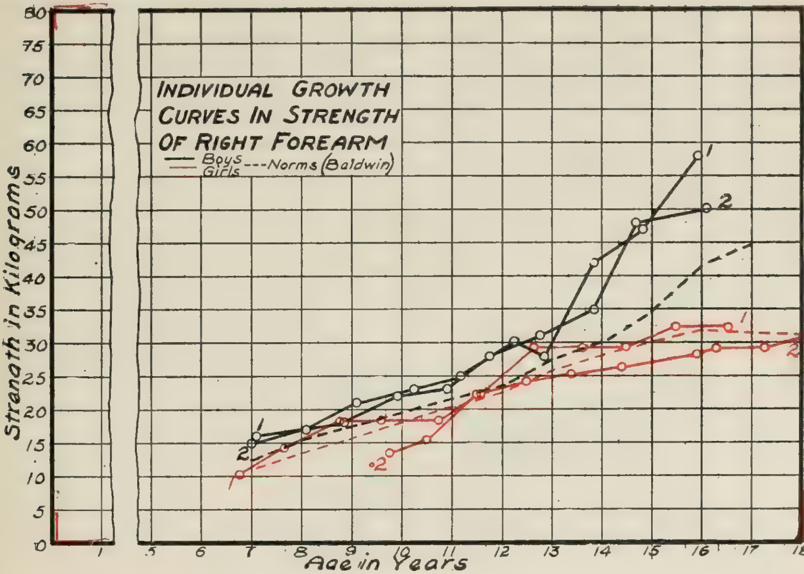

INDIVIDUAL GROWTH CURVES IN BREATHING CAPACITY
Boys
Girls
Breathing Capacity in Deciliters
Age in Years

Chart XXXIV

(4) *Chest Girth.* (a) *Brothers.* For chest girth there are more fluctuations in all of the curves. This may be attributed, in part at least, to the unreliability of this measurement, due to the fact that



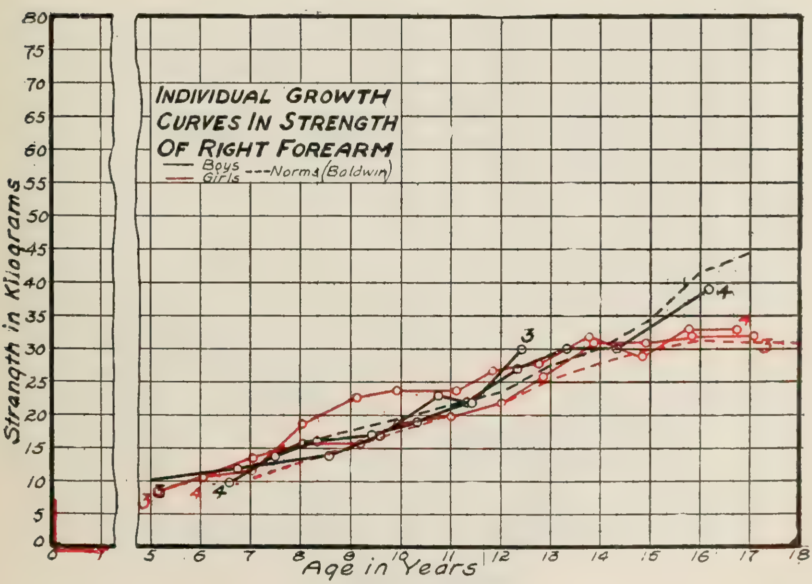
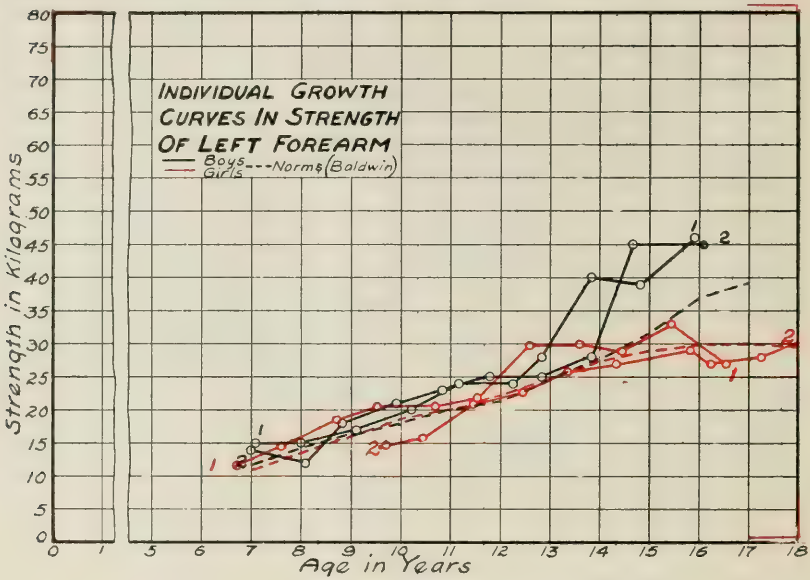


Chart XXXV

the muscle tissue of the chest makes it difficult to maintain an equal degree of tautness of the tape and also the fact that the volume of air in the lungs can not be kept constant from year to year.



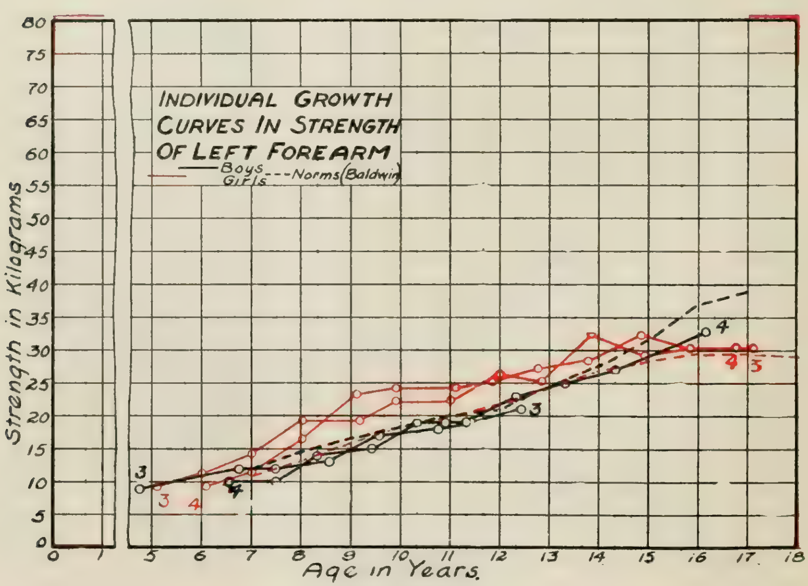


Chart XXXVI

The smaller brother (*2*) fluctuates more than (*1*), showing a marked acceleration at 12 to 14 years of age and a distinct regression at 16 years of age. The other brothers (*3*) and (*4*) show less fluc-

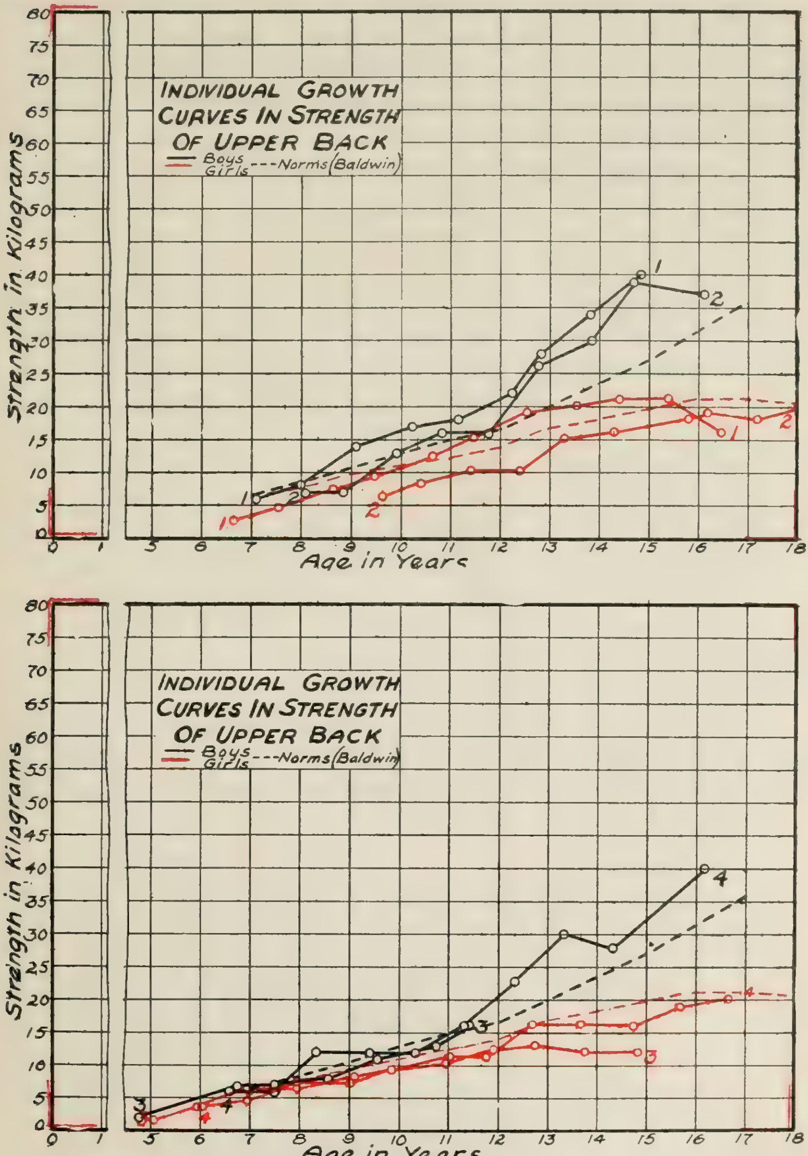


Chart XXXVII

tuation and their relative development is similar to their relative development in height.

(b). *Sisters.* For the two pairs of sisters, the girths of chests vary even more than for the brothers, both among themselves and among the group. The period of greatest acceleration is earlier for the girls, no doubt due to muscular and glandular development, as well as to actual increase in breathing capacity. The slowing up of growth starts very early for (*1*), (*2*) and (*3*). The anaemic condition, round shoulders and poor health of (*3*) show in a striking manner in this measurement. The poor health of all of the girls is apparent here, regardless of the fact that all are receiving remedial exercises.

(5) *Breathing Capacity.* (a). *Brothers.* In breathing capacity (*1*) and (*2*) are above the norm and maintain their relative position to each other while (*3*) and (*4*) approach the norm for the group.

(b). *Sisters.* The two pairs of sisters hold relatively the same position as the two pairs of brothers.

(6) *Strength of Arms and Upper Back. Arms.*

(a). *Brothers.* The development in strength for the two pairs of brothers varies from the development of the other physical traits in that the same relative positions are not maintained. (*1*) and (*2*) are still superior to (*3*) and (*4*), but (*2*) is here almost as strong as (*1*) and (*3*) exceeds (*4*) by only a small degree. The curves for strength indices are comparatively regular.

(b). *Sisters.* With the sisters (*1*) and (*2*) are equal in strength at 11 years 4 months, but (*1*) later regains her supremacy. Neither are very strong for girls. For (*3*) and (*4*) the curves are flattened and as in the case of the other two sisters, there has not been the growth found in normally developed girls with good health.

Upper Back.

(a). *Brothers.* For development in strength of upper back the smaller of the first set of brothers (*2*) almost equals the larger and heavier one (*1*), and (*4*), the smallest of the group, equals (*1*), the largest, in this physical trait. The other brother (*3*) also shows a close resemblance to (*4*) as far as comparison is possible. In strength development for these four boys of good normal growth, there is less difference between brothers and less difference between the two pairs than for the other traits.

(b). *Sisters.* For the two pairs of sisters in strength of upper back (*1*) is superior until 16 years of age when there is a decrease;

for the smaller sister (*2*) the development is similar to (*1*) but inferior until 16 years of age. Of the other two sisters (*4*) is as strong at all ages as (*3*) or superior and at 17 she is superior to (*1*) and (*2*).

These comparative curves show that while two brothers or two sisters may differ in the gross measurements in the various traits shown, there is a similarity in proportional increment of growth for the pairs, except in the strength tests, where the individual gross differences between two brothers or two sisters is not so marked.

(7) *Conclusions*

1. HEIGHT.

I. The individual growth curves in stature of two brothers or two sisters show that the one may be taller than the other, but the curves are strikingly similar in their appearance.

II. If the curves of growth are thought of as parallel or concentric curves which give an index of physiological stages of growth, it will be noted that for the first two brothers, (*1*) and (*2*), the relative variation in height at any one physiological age is not more than a few centimeters. The second pair of brothers shows very little variation in relative height.

2. WEIGHT.

I. Variations in weight for brothers and for sisters are more marked than in development in stature.

II. In the case of the two pairs of sisters, there is more variation in weight, which is probably due to the prolonged disease history of each.

3. SITTING HEIGHT.

I. Sitting height shows more variations than standing height, probably due to round shoulders and poor posture.

4. STRENGTH OF ARMS AND UPPER BACK.

I. Boys and girls who hold their relative positions in development in stature do not, in these cases, maintain the same relative positions in strength of arms and upper back.

II. These comparative curves show that while two brothers or two sisters may differ in the gross measurements in the various traits shown, there is a similarity in the proportionate incre-

ment of growth for the pairs, excepting the strength tests, where the individual gross difference between two brothers or two sisters is not so marked.

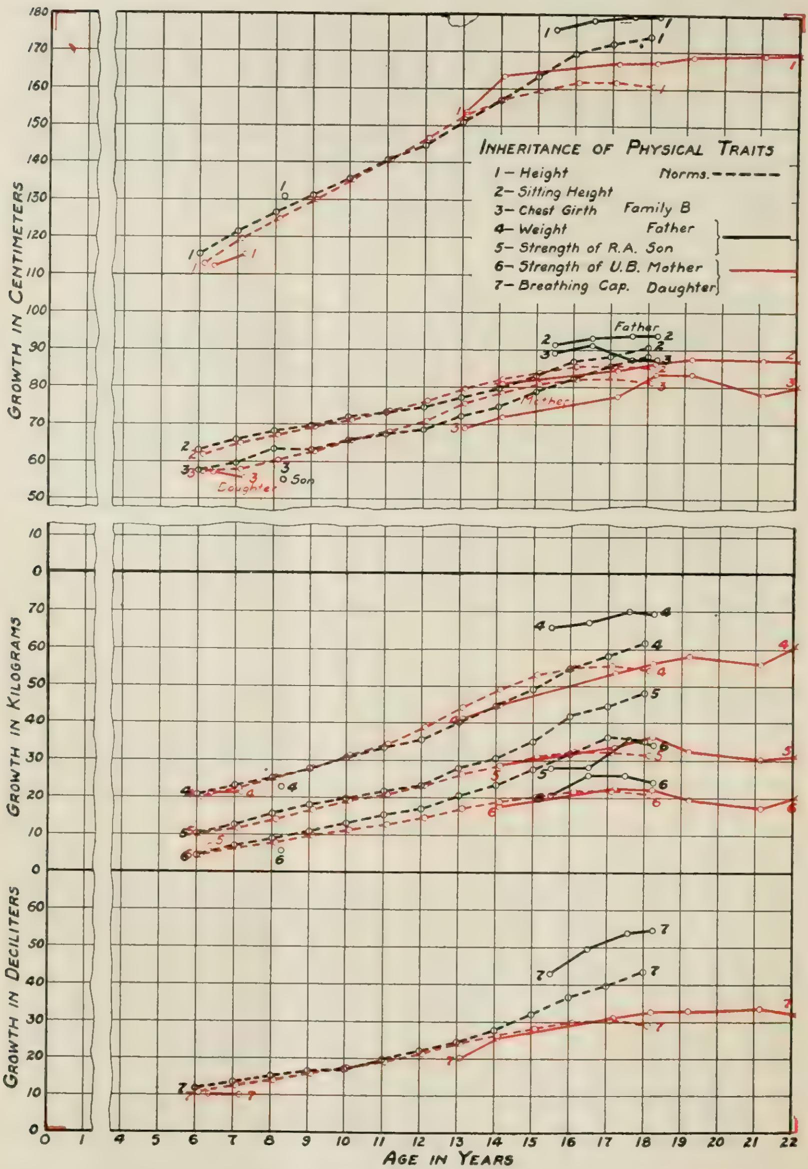


Chart XXXVIII

D. THE INHERITANCE OF PHYSICAL TRAITS

A preliminary study is now being made of the inheritance of physical traits. Chart XXXVIII represents a method of recording the growth data. In family B the mother's measurements are given from 1900 to 1909, beginning at 13 years of age; the father's measurements begin at 15½ years in 1902, and the daughter's at six years three months, in 1919, and the son's in 1919 at the age of eight years three months.

In another family, for example, the measurements were taken from 12 years to 17½ years for the mother, and for the daughter from seven to 10 years of age; in another family the father's measurements have been carefully taken from 12 to 18 years of age, one daughter's from seven to nine years of age, another from 10 to 11 and another from six to seven years of age. In another family the mother's measurements were carefully recorded from 16 to 21 years of age, the daughter's from six to eight years of age, and the son's from four to five years of age. These measurements will be continued and in the course of a few years a definite report on family histories will be issued.

E. INDIVIDUAL PERCENTILE PROFILES OF GROWTH

The percentile increase in growth for individuals, as far as the writer can determine, is here worked out for the first time by means of consecutive profiles. In charts XXXIX to XLI are shown the percentiles in a series of individual profiles for two boys and two girls from seven to 17 years of age for eight to 12 successive measurements on a series of from 15 to 22 physical traits. The first column at the left gives the age of the child, the ordinates represent physical traits, and the abscissæ the percent of gain over the initial measurement at the lowest age indicated. This first series of measurements in each trait is taken as 100 percent for the trait indicated. The circles mark the percent of growth in each particular physical trait. The curves (the heavy lines and circles) give a cross section view of the percental growth of the individual for the time period included and the series gives the successive profiles. Tables XIII, XIV, XV on pages 108, 109 and 110 give type cases.

In table XIII there are shown the initial measurements in twenty-two traits for a boy of five years, 11 months old, and the percent of gain for the successive time intervals is indicated to the age of 16 years and seven months. The results for height, for ex-

TABLE XIII

PERCENT TABLE OF INDIVIDUAL GROWTH FROM KINDERGARTEN THROUGH HIGH SCHOOL. BOY*

Traits	5 yrs. 11 mos. Initial Meas. 100%	6 yrs. 8 mos. % gain	7 yrs. 10 mos. % gain	8 yrs. 8 mos. % gain	9 yrs. 11 mos. % gain	10 yrs. 8 mos. % gain	11 yrs. 9 mos. % gain	12 yrs. 10 mos. % gain	13 yrs. 11 mos. % gain	15 yrs. 7 mos. % gain	16 yrs. 7 mos. % gain
1. Height	118.0	3.05	8.98	12.01	19.00	22.05	26.2	29.4	32.7	38.2	45.7
2. Sitting Height	62.2	4.84	8.37	12.89	15.75	17.85	21.1	23.3	25.5	29.9	37.3
3. Girth, Chest	59.6	9.73	5.04	8.73	12.09	17.10	20.3	25.0	25.5	34.4	43.2
4. Girth, Chest exp.	63.2	6.65	4.75	8.55	14.90	15.50	20.6	25.0	29.75	32.6	34.8
5. Girth Ninth Rib	58.4	6.16	3.42	8.56	14.70	13.90	18.2	20.7	21.6	25.17	35.3
6. Girth Ninth Rib exp.	60.0	8.66	6.00	10.00	15.33	15.33	20.5	23.34	26.76	30.00	38.3
7. Depth Chest	14.8	8.11	1.35	—1.35	4.5	4.5	4.73	6.08	12.16	16.89	16.2
8. Depth Chest exp.	15.2	11.85	5.26	7.89	9.22	11.18	15.8	19.0	32.7	30.4	26.6
9. Breadth, Chest	19.0	7.36	7.36	8.42	13.7	15.76	17.9	22.1	23.7	30.0	37.4
10. Weight	22.3	19.3	29.15	35.90	56.8	65.40	82.5	101.2	109.9	119.8	168.5
11. Lung Capacity	50.0	48.0		76.00	94.0	108.0	120.0	160.0	188.0	208.0	284.0
12. Strength, Forearm R.	12.0	16.7	16.7	50.10	66.8	100.0	108.0	108.0	175.0	158.0	291.0
13. Strength, Forearm L.	12.0	16.7	25.0	50.10	66.8	75.0	75.0	75.0	100.0	133.3	241.5
14. Strength, Upper Back	5.0	20.0	120.0	140.00	180.0	220.0	280.0	380.0	420.0	380.0	500.0
15. Strength, Chest	10.0	20.0	50.0	50.0	100.0	110.0	130.0	140.0	180.0	210.0	260.0

* Horace Mann School.

TABLE XIV

PERCENT TABLE OF INDIVIDUAL GROWTH FROM KINDERGARTEN THROUGH HIGH SCHOOL. GIRL*

	7 yrs. 2 mos.	8 yrs. 0 mos.	8 yrs. 11 mos.	10 yrs. 0 mos.	10 yrs. 11 mos.	11 yrs. 11 mos.	13 yrs. 11 mos.	14 yrs. 11 mos.	16 yrs. 3 mos.	16 yrs. 9 mos.
Traits	Initial Meas. 100%	% gain	% gain	% gain	% gain	% gain	% gain	% gain	% gain	% gain
1. Height	118.6	3.38	8.27	13.3	17.2	22.4	23.05	24.7	25.25	25.80
2. Height, Sitting	66.0	1.52	6.06	9.1	12.1	17.3	22.7	25.15	29.4	30.9
3. Girth, Chest	58.4	9.58	10.95	18.2	18.5	22.3	35.3	48.3	48.3	50.3
4. Girth, Chest exp.	60.8	9.21	10.5	17.75	16.8	22.7	36.8	45.7	45.7	49.3
5. Girth, Ninth rib	57.0	7.02	8.77	17.55	17.9	19.3	31.6	35.1	43.2	45.9
6. Girth, Ninth rib exp.	59.0	10.15	10.85	18.65	19.0	22.35	33.9	39.0	43.3	45.7
7. Depth Chest	14.0	4.28	7.14	7.14	11.42	11.42	25.7	32.8	35.7	39.3
8. Depth Chest exp.	15.0	1.33	5.35	8.00	10.68	12.0	21.3	28.0	30.6	32.0
9. Breadth, Chest	18.4	6.53	7.60	15.2	15.2	19.59	29.4	37.5	38.1	42.9
10. Weight	26.1	8.43	13.04	29.5	34.8	50.2	99.2	89.7	91.6	101.0
11. Lung Capacity	60.0	30.0	40.0	40.0	70.0	103.0	156.4	183.4	180.0	190.0
12. Strength, Forearm R.	12.0	00.00	16.68	50.00	50.00	100.00	150.0	158.3	158.3	183.4
13. Strength, Forearm L.	8.0	37.5	75.0	125.0	125.0	175.0	225.0	287.5	300.0	287.5
14. Strength, Upper Back	6.0	83.3	100.0	150.0	150.0	150.0	200.0	300.0	300.0	266.6
15. Strength, Chest	6.0	116.8	116.8	166.8	200.0	200.0	266.6	266.6	400.0	423.3

* Horace Mann School.

ample, show that for the first interval (nine months) there has been a gain of 3.05 percent, for the second period of 14 months, 8.98 percent, and so on until the last age, 16 years, seven months, where the gain has amounted to 45.7 percent over the first meaurement. In strength of upper back there has been a gain of 500 percent. For the depth of chest, the results show that there has

TABLE XV

PERCENT TABLE OF INDIVIDUAL GROWTH FROM 11 YEARS TO 16 YEARS, SEVEN MONTHS*

Age	11 years	16 years 7 months
	Initial Meas.	% gain
1. Weight	29.0	47.9
2. Height, Standing	139.6	17.4
3. Height, Sitting	74.6	12.2
4. Girth, Neck	26.9	8.22
5. Girth, Chest (Repose)	68.5	10.50
6. Girth, Chest, (Inf.)	71.5	13.4
7. Girth, 9th Rib, (Repose)	59.3	12.2
8. Girth, 9th Rib, (Inf.)	62.3	16.1
9. Girth, Waist (Repose)	56.5	10.3
10. Girth, Waist, (Inf.)	57.8	9.34
11. Girth, Hips	65.2	15.6
12. Girth, Thigh, (R.)	37.4	13.9
13. Girth, Thigh, (L.)	36.3	16.8
14. Girth, Calf, (R.)	26.3	17.9
15. Girth, Calf, (L.)	25.7	20.2
16. Girth, Up. Arm, R. (Ext.)	17.6	19.3
17. Girth, Up. Arm, R. (Flex.)	19.0	23.7
18. Girth, Up. Arm, L. (Ext.)	17.2	16.3
19. Girth, Up. Arm, L. (Flex.)	18.9	16.9
20. Girth, Forearm, (R.)	19.6	20.4
21. Girth, Forearm, (L.)	19.1	15.2
22. Breadth, Shoulders	30.8	16.9
23. Breadth, Chest	20.4	11.8
24. Breadth, Waist	19.5	20.5
25. Breadth, Hips	22.1	23.1
26. Depth, Chest	16.0	12.5
27. Depth, Abdomen	15.5	3.23
28. Strength, Back	55.0	63.6
29. Strength, Legs	70.0	100.0
30. Strength, Chest	18.0	69.4
31. Strength, Forearm, (R.)	17.0	47.1
32. Strength, Forearm, (L.)	17.0	47.1
33. Capacity, Lung	143.0	32.9

* Baltimore Friends' School

been a gain of 16.2 per cent at the final measurement, 16 years, seven months, over the initial measurement at five years, 11 months.

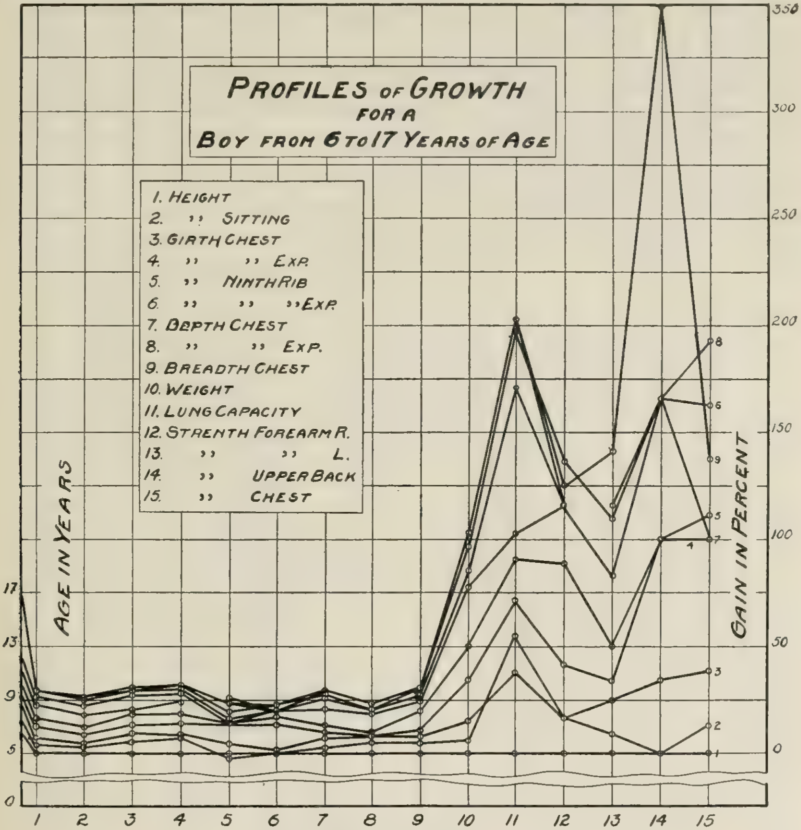


Chart XXXIX

1. *Conclusions*

I. The synoptic profiles for the individual boys differ from those for the girls. Except in height, standing and sitting, and weight, the girls show a higher percent of gain over the initial growth, taken as 100 percent, than do boys. This is particularly true of all of the strength measurements. For the nine traits considered previous to weight, the percent of gain for the eight to ten year interval, in the case of the boys, is always less than 50 percent and frequently not more than 25 percent. None of the strength tests for the boys exceeds 210 percent except in one instance for upper back, while for the girls

strength of the arms, back and chest frequently exceeds this amount and with one girl strength of right forearm reaches 350 percent, strength of chest 420 percent, and strength of upper back 850 percent.

II. The consecutive profiles for the same individuals are similar in their depressions, plateaus and peaks, with the greatest variation in the strength measurements.

III. The individual profiles furnish a tangible method for clinical diagnosis of the growth of individuals.

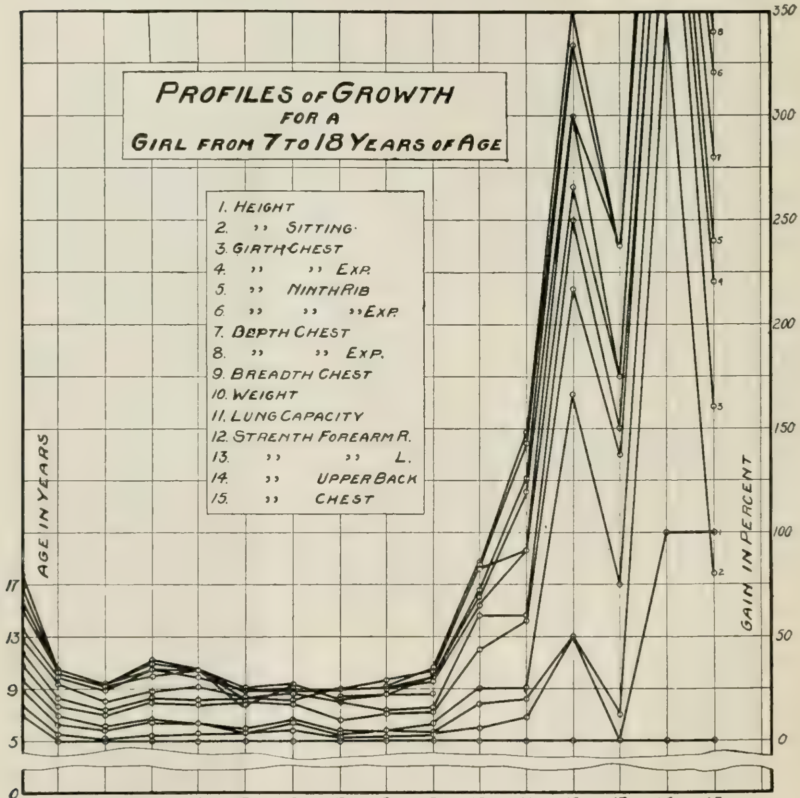


Chart XL

2. *Applications*

The consecutive profile charts furnish a practical means for recording the consecutive development of individual children. In order to use this method, a school should have a number of the charts made from a plate, 100, 1000 or more as the conditions require. The "blank charts" should contain the measurements to be recorded and the cross sections as indicated in Charts XXXIX to XLII. One chart should be provided for each pupil. The age of the pupil at first measurement should be indicated on the left margin as the basal age and all of the first measurements on their respective abscissas (cross section points on the horizontal lines)

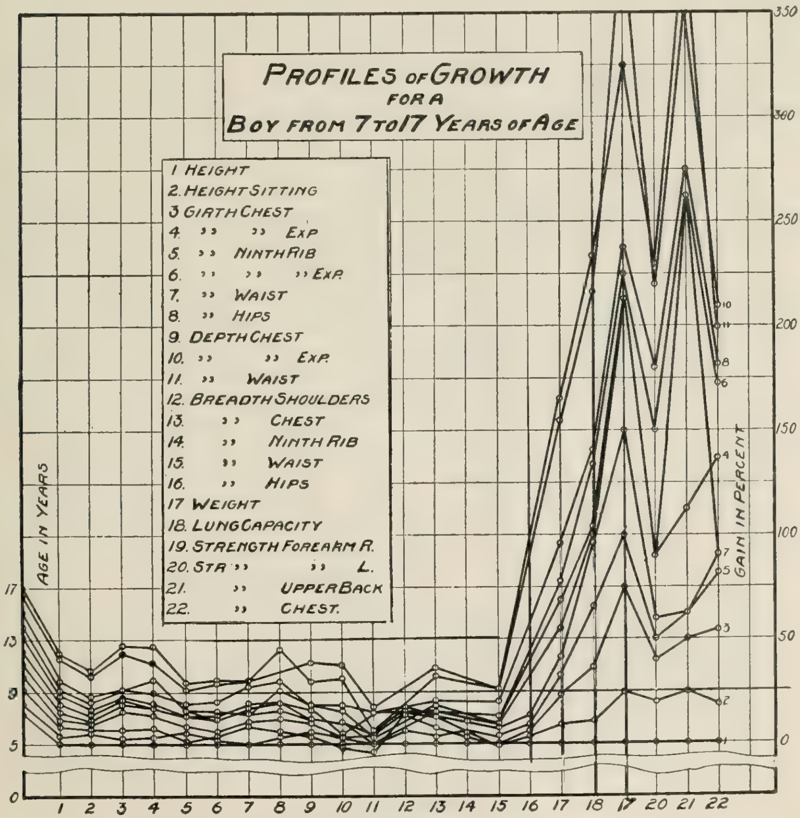


Chart XLI

at the 0 point. For the second measurement the age should be indicated on the left and the percents of gain over the initial measurements recorded on their respective ordinates (vertical lines) at relative distances from the 0 line. Each profile should be numbered in order (1st, 2nd, 3rd, etc.)

These profiles furnish excellent synoptic pictures of physical development for use by teachers, medical examiners, physicians, parents, and pupils. Another form of consecutive growth curves for nine physical traits is illustrated in Charts XLIII and LIV. Constructed from the records from Washington, D. C.

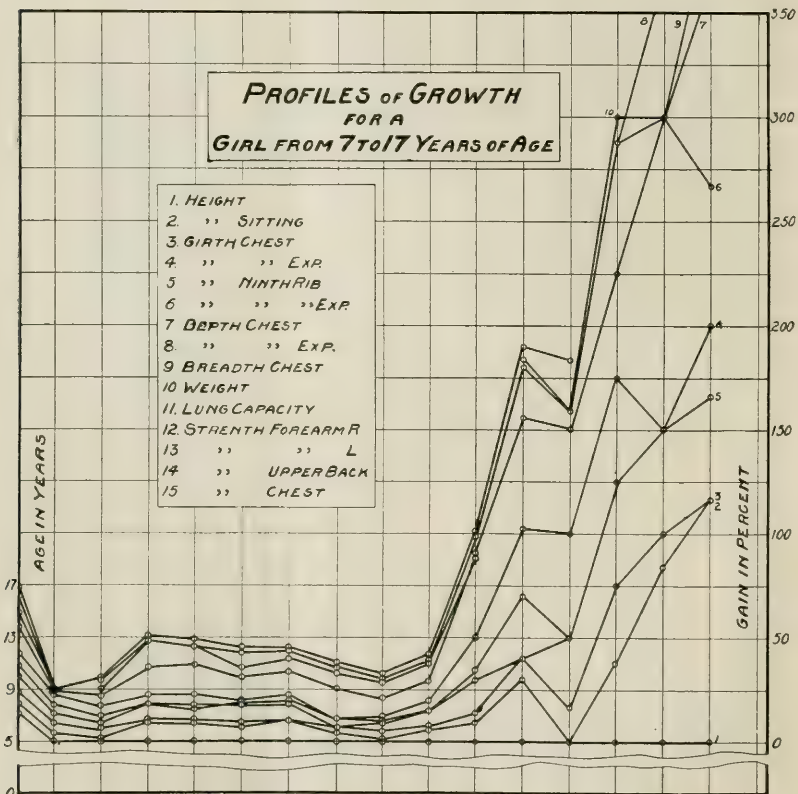


Chart XLII

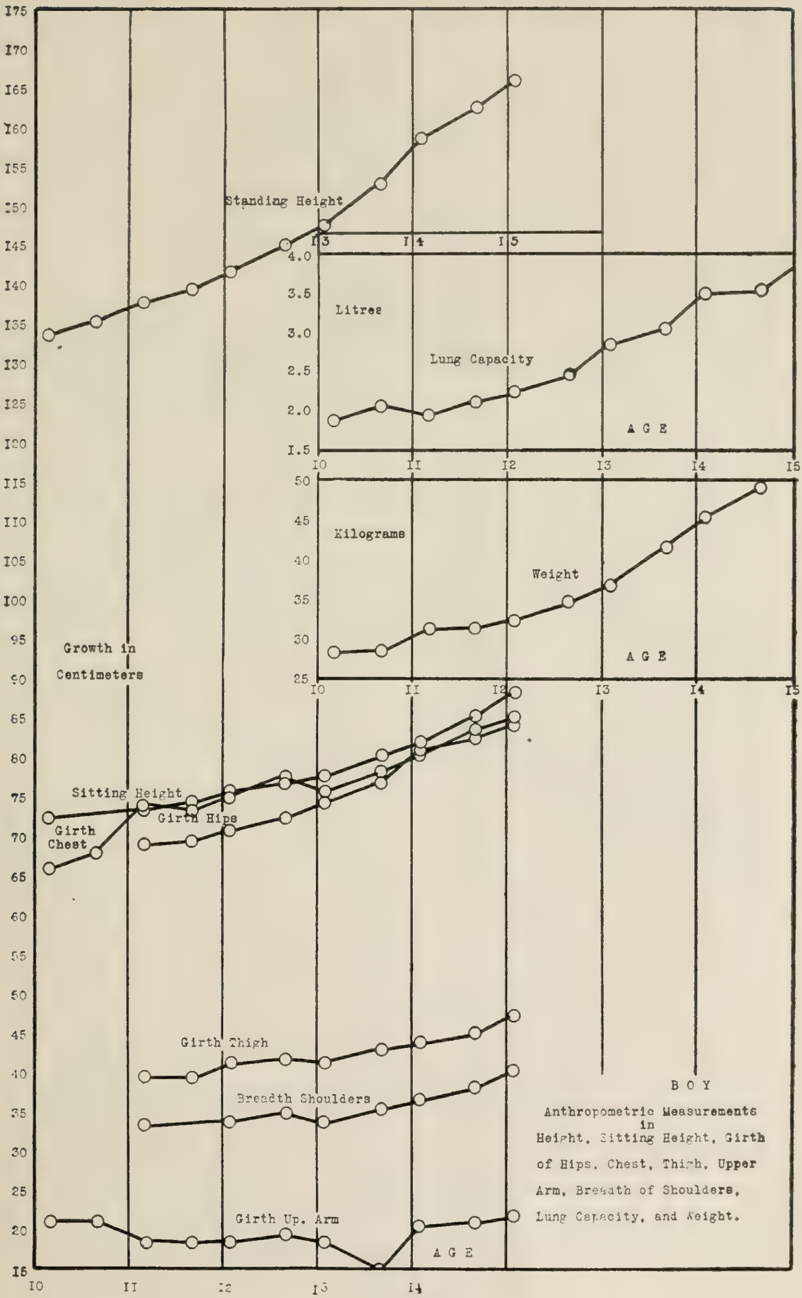

Standing Height
Litres
Lung Capacity
AGE
Kilograms
Weight
AGE
Growth in Centimeters
Sitting Height
Girth Hips
Girth Chest
Girth Thigh
Breadth Shoulders
Girth Up. Arm
AGE
BOY
Anthropometric Measurements in Height, Sitting Height, Girth of Hips, Chest, Thigh, Upper Arm, Breadth of Shoulders, Lung Capacity, and Weight.

Chart XLIII

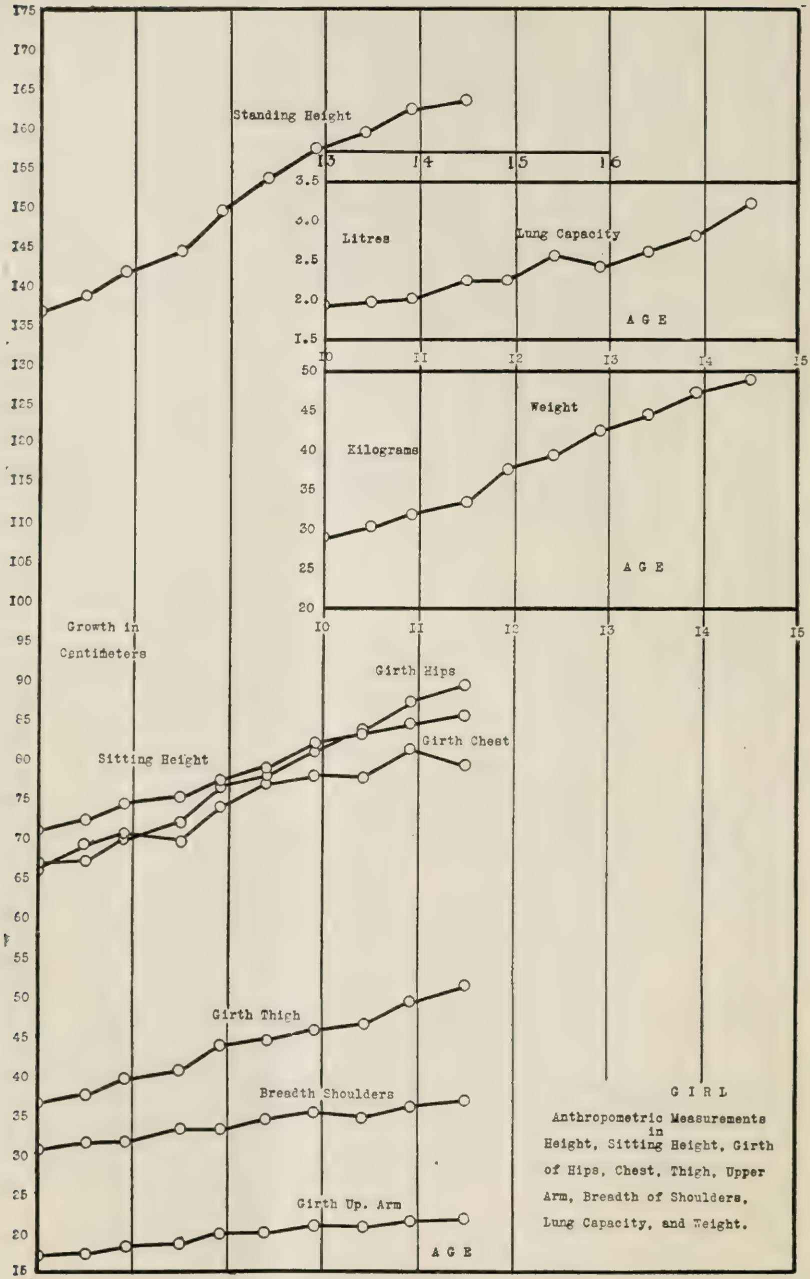

Standing Height
Lung Capacity
Litres
Weight
Kilograms
Growth in Centimeters
Girth Hips
Girth Chest
Sitting Height
Girth Thigh
Breadth Shoulders
Girth Up. Arm
A G E
G I R L
Anthropometric Measurements in Height, Sitting Height, Girth of Hips, Chest, Thigh, Upper Arm, Breadth of Shoulders, Lung Capacity, and Weight.

Chart XLIV

CHAPTER VI

CORRELATION COEFFICIENTS IN THE PHYSICAL GROWTH OF BOYS AND GIRLS

1. Total and Partial Growth

A. DATA.

This chapter gives briefly in a statistical and graphic form a summary of the correlations of the yearly measurements of growth in height, weight and breathing capacity, with sitting height, girth of chest, strength of right arm, strength of left arm and strength of upper back.

The investigation, of which this section is a partial report, aims to discover the relationships that exist between total growth of the body and the corresponding growth of a limited number of parts and psycho-physical functions when based upon consecutive measurements of the same individuals, in a group of boys and girls from the ages of seven to 17, and in another group of 80 college girls from 17 to 20 years of age.

For the school children the results are based on selected half-yearly consecutive measurements for periods from six to 10 years, on an average of 60 well developed children for each age for each sex. The original measurements were made on nude children who for several years had been subjected to school medical inspection, physical training and directed play. The semi-annual measurements made it possible to select a measurement which fell within at least three months of the child's exact birthday. The number of children could have been increased by including those with fewer or more irregular intervals of measurements and those deviating from the "normal type", but this seemed undesirable. The children represent good types of development, the measurements and the time intervals are accurate and the observations are consecutive for several years. For purposes of discovering relationships through the method of correlation, the numbers are sufficiently large and the probable error so uniformly small, that the tendencies discovered are no doubt accurate for this group of children, and may

serve as standards for comparison with different racial, economic, and mental types as to sex and age development. Correlations for the consecutive development of these physical traits for these ages or for a period of years with consecutive measurements have not been worked out before so far as the writer has been able to determine.

B. TABULATED RESULTS. (See pages 120 and 121).

2. Analysis of Correlated Traits: Total Correlations

A. SCHOOL CHILDREN.*

(1) *Height-Weight.* The correlations between the yearly measurements of height and weight during the ten-year period of childhood from seven to 17 years of age for both boys and girls are higher than the correlations between height and girth of the chest and strength of arms and upper back, but lower than the correlations between height and sitting height for both boys and girls. They are higher than the correlations between height and breathing capacity for boys, but lower for girls.

The relation between the yearly measurements of growth in height and weight for boys is relatively uniform from seven to 11 years of age (the coefficient of correlation varies from + .850 to + .876). The coefficient drops to + .782 and + .790 at 12 and 13 years of age and reaches the maximum, (+ .877) at 14 years. The coefficient is at the minimum (+ .668) at 16 years and is + .680 at 17 years. The correlation between height and weight is not so high for girls as for boys. For girls, the coefficient is + .581 at 11 years of age and reaches the maximum (+ .693) at 12 years of age. At 16 years the relationship is less marked, (the coefficient is + .486). The averages of the coefficients for the ten-year period are + .809 for boys and + .603 for girls.

(2) *Height-Breathing Capacity.* The correlations between the yearly measurements of height and breathing capacity are higher than the correlations between height and girth of chest, strength of arms and strength of upper back for both boys and girls. These correlations are higher than the height and weight correlations for girls, but lower than those for boys.

This section gives a direct analysis of the tabulated data without attempting to evaluate the significance of the minor fluctuations in the coefficients. In some instances the differences noted are within

* Data from Horace Mann School, Teachers College, Columbia University.

the range of the probable error; and they may or may not be significant.

Between these two traits, the relation is very high from seven to nine years for the boys (the coefficients being +.784 to +.817) with probably a slight decrease to 13 years (+ .738). The maximum coefficient is + .812 at 15 years. The correlations for the girls are different from those for the boys. The coefficient is low at seven years, but increases steadily to + .746 at 13 years. The averages of the coefficients for the ten year period are +.745 for the boys and +.669 for the girls.

(3) *Height-Sitting Height.* In these correlations the sitting height is, of necessity, included in the standing height measures, which probably tends to raise the coefficients. The coefficients show that growth in height bears a closer relation to growth in sitting height for both boys and girls than do any of the other physical traits measured. For the boys there is a decrease in the coefficient from + .963 at seven years to + .783 at 17 years. The coefficients for the girls are irregular from seven to 11 years, + .921 at seven years, + .670 at eight years, + .871 at nine years, + .832 at 10 years. The maximum coefficient is + .933 at 12 years. After this the coefficients are about the same as for boys, falling gradually to + .754 at 17 years. The average coefficient of correlation for the ten-year period is + .901 for boys, and + .858 for girls.

(4) *Height-Girth of Chest.* The coefficients of correlation between the yearly measurements of height and the girth of the chest are lower than the coefficients between height and weight, breathing capacity, and sitting height, but higher than between height and strength of the left arm for both boys and girls. Height correlates higher with girth of the chest than with strength of the right arm or with strength of the upper back, in the case of the boys, but lower in the case of the girls.

The coefficients between height and girth of the chest drop from +.716 at seven years to +.595 at eight years, increase to +.721 at 10 years, drop to + .559 at 13 years, increase to + .756 at 14 years, and then gradually decrease to + .556 at 17 years. The coefficients for girls are + .527 and + .559 at seven and nine years; + .431 at 10 years; + .556 at 12 years and gradually decrease to + .332 at 16 with a slight increase at 17 years. The averages of the coefficients for the ten year period are + .655 for the boys and + .465 for the girls.

TABLE XVI

INTERCORRELATIONS FOR BOYS

The Coefficients of Inter-correlation (Pearson formula, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}}$ P. E.= $\frac{.6745\ (1-r^2)}{\sqrt{n}}$, for Height, Weight, Breathing Capacity, Sitting Height, Girth of Chest, Strength of Arms and Strength of Upper Back for Boys from Seven to 17 Years of Age.

	*Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Coef. ± P. E.		Av. Coef.
Age	7		8		9		10		11		12		13		14		15		17		16		
1. Height-Weight	.872	.035	.850	.030	.876	.022	.856	.024	.853	.022	.782	.030	.790	.029	.877	.019	.797	.031	.668	.056	.680	.055	.809
2. Height-Breathing Capacity	.799	.052	.784	.041	.817	.032	.763	.038	.740	.036	.767	.032	.738	.036	.779	.032	.812	.029	.661	.057	.530	.074	.745
3. Height-Sitting Height	.963	.010	.923	.016	.947	.010	.930	.012	.919	.012	.924	.011	.915	.013	.895	.016	.896	.017	.820	.033	.783	.040	.901
4. Height-Girth of Chest	.716	.070	.595	.069	.685	.051	.721	.043	.676	.043	.612	.048	.559	.054	.756	.035	.698	.044	.630	.061	.556	.071	.655
5. Height-Strength Right Arm	.488	.110	.699	.054	.593	.063	.641	.053	.610	.050	.497	.058	.655	.045	.614	.050	.551	.060	.456	.081	.440	.083	.568
6. Height-Strength Left Arm	.375	.124	.532	.077	.633	.058	.547	.063	.565	.055	.443	.062	.579	.052	.672	.044	.527	.062	.425	.083	.384	.088	.517
7. Height-Strength Upper Back	.548	.101	.300	.097	.460	.076	.554	.062	.636	.048	.548	.054	.555	.054	.587	.053	.397	.072	.234	.046	.264	.031	.462
8. Weight-Breathing Capacity	.801	.052	.695	.055	.739	.044	.707	.045	.711	.040	.722	.037	.733	.036	.771	.033	.787	.033	.748	.045	.612	.064	.730
9. Weight-Sitting Height	.833	.045	.800	.038	.858	.025	.818	.030	.808	.028	.739	.035	.791	.029	.837	.024	.784	.033	.759	.043	.607	.065	.785
10. Weight-Girth of Chest	.888	.030	.832	.033	.793	.036	.826	.028	.888	.017	.879	.018	.865	.020	.897	.016	.887	.018	.823	.033	.872	.025	.859
11. Weight-Strength Right Arm	.639	.085	.796	.039	.641	.057	.673	.049	.650	.046	.577	.051	.721	.037	.692	.042	.733	.040	.670	.056	.586	.068	.671
12. Weight-Strength Left Arm	.571	.097	.643	.063	.632	.058	.593	.058	.614	.050	.541	.054	.628	.047	.660	.046	.717	.042	.797	.037	.408	.086	.619
13. Weight-Strength Upper Back	.681	.077	.442	.086	.476	.074	.605	.057	.670	.044	.587	.050	.610	.049	.698	.041	.655	.049	.500	.076	.402	.086	.575
14. Breath. Cap.-Sitting Height	.843	.042	.752	.046	.793	.036	.690	.047	.748	.035	.743	.035	.755	.033	.789	.030	.818	.028	.728	.048	.535	.073	.745
15. Breath. Cap.-Girth of Chest	.768	.059	.621	.066	.643	.057	.667	.050	.650	.046	.732	.036	.712	.038	.715	.039	.740	.039	.704	.051	.634	.062	.690
16. Breath. Cap.-Strength R. Arm	.595	.093	.588	.070	.523	.070	.623	.055	.535	.057	.527	.056	.627	.047	.663	.045	.637	.051	.514	.075	.428	.084	.569
17. Breath. Cap.-Strength L. Arm	.506	.107	.525	.078	.556	.066	.510	.066	.464	.063	.480	.059	.653	.045	.682	.043	.563	.059	.505	.076	.342	.091	.526
18. Breath. Cap.-Strength U. Back	.559	.099	.468	.083	.394	.081	.563	.061	.618	.049	.627	.047	.529	.056	.589	.053	.582	.057	.438	.082	.354	.090	.520
19. Strength R. A.-Strength L. A.	.866	.036	.736	.049	.865	.024	.709	.044	.787	.031	.797	.028	.788	.030	.860	.021	.843	.025	.852	.028	.850	.029	.814

*All of the coefficients of correlations are positive (+) in this section of the Study. These coefficients were worked out in 1917, when the writer was at Johns Hopkins University, where he had the assistance of one of his students, W. F. Shenton.

TABLE XVII

INTERCORRELATIONS FOR GIRLS

The Coefficients of Inter-correlation (Pearson formula, $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \, \Sigma y^2}}$ P. E.$= \frac{.6745 \, (1-r^2)}{\sqrt{n}}$, for Height, Weight, Breathing Capacity, Sitting Height, Girth of Chest, Strength of Arms and Strength of Upper Back for Girls from Seven to 17 Years of Age.

Age	7		8		9		10		11		12		13		14		15		16		17		
	*Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Coef.	± P. E.	Av. Coef.
1. Height-Weight	.559	.092	.636	.070	.638	.063	.638	.056	.581	.050	.693	.041	.645	.047	.666	.045	.542	.061	.486	.070	.547	.071	.603
2. Height-Breathing Capacity	.515	.098	.548	.082	.575	.071	.672	.052	.718	.042	.740	.036	.746	.036	.730	.038	.671	.048	.761	.038	.682	.054	.669
3. Height-Sitting Height	.921	.021	.670	.065	.871	.025	.832	.029	.925	.012	.933	.010	.931	.011	.898	.016	.848	.024	.851	.025	.754	.043	.858
4. Height-Girth Chest	.527	.097	.559	.081	.555	.073	.431	.077	.475	.066	.556	.055	.485	.062	.459	.064	.333	.077	.322	.082	.412	.084	.465
5. Height-Strength Right Arm	.801	.048	.689	.062	.521	.077	.423	.078	.580	.072	.541	.056	.551	.056	.574	.054	.388	.073	.455	.072	.208	.096	.521
6. Height-Strength Left Arm	.793	.049	.654	.067	.455	.084	.396	.080	.458	.068	.500	.060	.524	.059	.387	.069	.338	.077	.242	.085	.137	.099	.444
7. Height-Strength Upper Back	.606	.085	.446	.094	.433	.086	.408	.079	.411	.071	.525	.058	.567	.055	.563	.055	.508	.064	.410	.076	.343	.089	.475
8. Weight-Breathing Capacity	.463	.105	.643	.069	.434	.086	.509	.070	.564	.059	.620	.049	.606	.051	.544	.057	.318	.078	.470	.071	.516	.074	.517
9. Weight-Sitting Height	.505	.100	.482	.090	.638	.063	.618	.058	.646	.050	.691	.042	.657	.046	.692	.042	.516	.063	.512	.067	.510	.074	.588
10. Weight-Girth Chest	.877	.031	.887	.025	.927	.015	.893	.019	.936	.011	.929	.011	.912	.014	.882	.018	.883	.019	.865	.023	.851	.028	.895
11. Weight-Strength Right Arm	.540	.095	.502	.030	.429	.086	.525	.069	.494	.065	.502	.060	.641	.048	.576	.054	.470	.067	.437	.074	.361	.087	.498
12. Weight-Strength Left Arm	.529	.096	.425	.096	.400	.089	.478	.073	.496	.065	.569	.054	.499	.061	.421	.066	.403	.072	.341	.080	.258	.094	.438
13. Weight-Strength Upper Back	.433	.109	.424	.096	.434	.086	.386	.080	.351	.075	.414	.066	.467	.063	.538	.057	.381	.074	.416	.075	.434	.082	.425
14. Breath. Cap.-Sitting Height	.589	.097	.430	.096	.675	.057	.548	.066	697	.044	.590	.052	.762	.034	.696	.042	.614	.054	.688	.048	.654	.058	.631
15. Breath. Cap.-Girth Chest	.536	.095	.717	.057	.419	.087	.450	.075	.473	.067	.506	.059	.540	.057	.492	.061	.490	.066	.443	.073	.439	.081	.500
16. Breath. Cap.-Strength R. Arm	.694	.069	.383	.100	.377	.090	.379	.081	.584	.056	.419	.066	.479	.062	.429	.066	.291	.079	.419	.075	.163	.098	.420
17. Breath. Cap.-Strength L. Arm	.572	.090	.452	.093	.387	.090	.398	.080	.496	.065	.408	.066	.444	.065	.400	.068	.255	.081	.246	.085	.120	.099	.380
18. Breath. Cap.-Strength U. Back	.681	.072	.445	.094	.461	.083	.323	.085	.521	.063	.389	.068	.511	.060	.447	.065	.293	.079	.290	.083	.190	.097	.414
19. Strength R. A.-Strength L. A.	.866	.034	.805	.041	.810	.036	.834	.029	.797	.031	.806	.028	.821	.026	.804	.029	.861	.022	.670	.050	.642	.059	.792

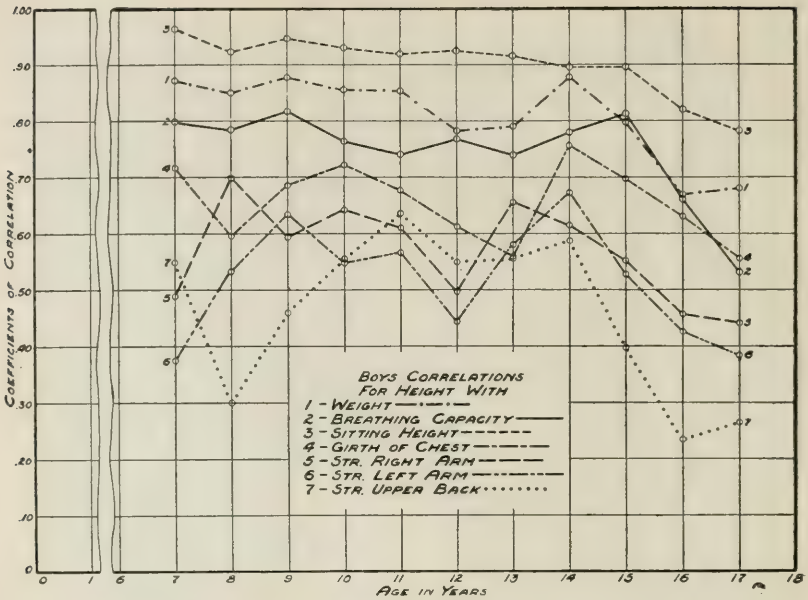


Chart XLV

Chart XLVI

(5 and 6). *Height-Strength of Arm.* For both boys and girls the correlations between the yearly measurements of height and strength of the arm are lower than between height and any of the other physical traits measured except the strength of the upper back.

Height bears about the same relation to strength of the right arm as to strength of the left arm. The correlation is high for boys at eight and nine years, but drops to +.497 for the right arm and + .443 for the left at 12 years. The coefficients increase to + .655 for the right at 13 years and + .672 for the left at 14 years. After that time the correlation coefficients decrease to + .440 and + .384 for left and right arm, respectively, at 17 years. The relation between height and strength of the arm for girls is very irregular. At seven years, the coefficients are + .801 with the right arm and + .793 with the left arm. They decrease to + .423 and + .396 at 10 years, increase again to + .574 for the right arm at 14 years and + .524 for the left at 13 years. They decrease to + .208 and + .137 at 17 years. The averages of the coefficients are: height with right arm + .568 for boys and + .521 for girls and with left arm + .517 for boys and + .444 for girls.

(7) *Height-Strength of Upper Back.* The correlations between the yearly measurements of height and strength of the upper back are lower than the correlations between height and the other six physical traits at all years in the case of the boys and from seven to 11 years in the case of the girls. After 11 years, these correlations for girls are higher than with the strength of the arms and the girth of the chest.

For the boys, the coefficient of correlation is +.300 at eight years, rises to + .636 at 11 years, drops to + .587 at 14 years and drops rapidly to the minimum, + .234 at 16 years. There are no such marked differences in the correlation coefficients of the girls from year to year. The coefficient is + .606 at seven years, decreases to + .408 at 10 years, rises to + .567 at 13 years, and is + .343 at 17 years. The averages of the coefficients are + .462 for boys and + .475 for girls.

(8) *Weight-Breathing Capacity.* The correlations between the yearly measurements of weight and height, sitting height, and girth of chest are higher than with breathing capacity for both boys and girls.

The correlation is highest for the boys at seven years (+.801) and

at eight years (+ .695.) The coefficient gradually increases to +. 787 at 15 years and is + .617 at 17 years. The correlation between weight and breathing capacity is not high for girls and there is much wider variation from year to year. The coefficient drops from + .643 at eight years to + .434 at nine years and then gradually increases to the maximum (+ .620) at 12 years. The minimum (+ .318) is reached at 15 years. The averages of the coefficients are + .730 for boys and + .517 for girls.

(9) *Weight-Sitting Height.* The coefficients of correlation between the yearly measurements of weight and sitting height are almost the same as those of weight and height, though slightly lower. They are also lower than the coefficients between weight and the girth of the chest.

With the boys, the coefficient is +.858 at nine years and +.739 at 12 years, + .837 at 14 years, and decreases to + .607 at 17 years. With the girls, the coefficient increases to + .692 at 14 years and then drops to + .510 at 17 years. The averages of the coefficients are + .785 for the boys and + .588 for the girls.

(10) *Weight-Girth of Chest.* Between the yearly measurements of weight and the girth of the chest the correlations are higher than for weight and any other physical trait measured.

The coefficients are fairly uniform throughout the ten years, varying from + .793 at nine years to + .897 at 14 years for the boys and from + .927 at nine years to + .851 at 17 years for the girls. The averages of the coefficients are +.859 for boys and +.895 for girls.

(11 and 12) *Weight-Strength of Arm.* The correlation coefficients between the yearly measurements of weight and strength of the arm are lower than between weight and height, breathing capacity, sitting height and the girth of the chest.

For the boys, the coefficients between weight and strength of the right arm are slightly higher than between weight and strength of the left arm. The coefficients vary from +.796 and +.643 for right and left respectively, at eight years, to + .577 and + .541 at 12 years. The coefficient increases to +.733 (weight with right arm) at 15 and + .797 (weight with left arm) at 16 years and then drops to + .586 and + .408 at 17 years. For the girls, the coefficients vary from +.540 and + .529 at seven years to + .429 and + .400 at nine years, increase to the maximum + .641, at 13 years (right arm) and + .569 at 12 years (left arm), and then

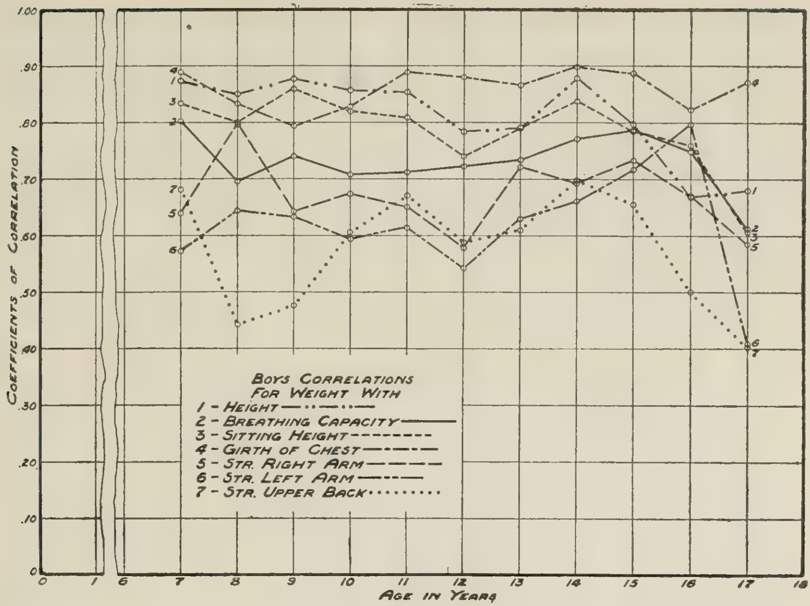


Chart XLVII

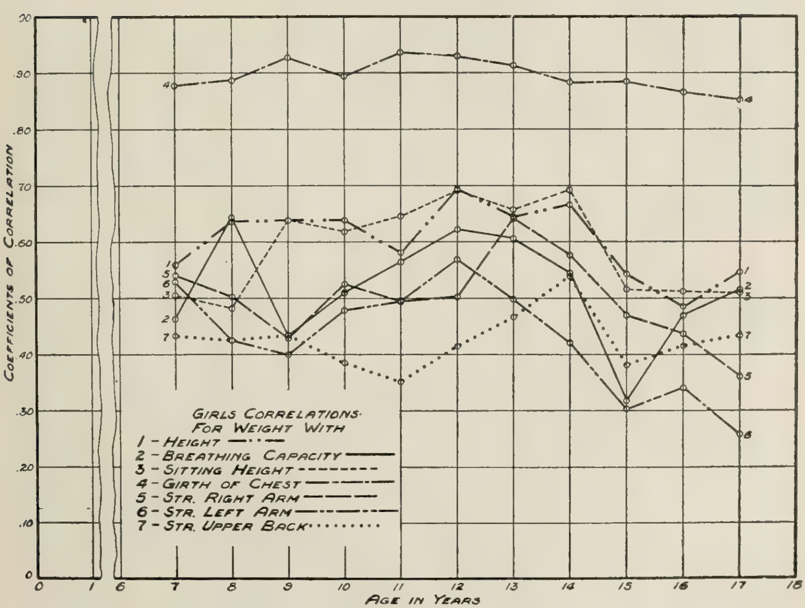


Chart XLVIII

gradually decrease to + .361 and + .258 at 17 years. The averages of the coefficients are: weight with strength of the right arm, +.671 for boys and +.498 for girls, and with strength of the left arm, +.619 for boys and +.438 for girls.

(13) *Weight-Strength of Upper Back.* The coefficients between the yearly measurements of weight and strength of the upper back are lower than any of the other weight correlations.

The coefficient drops from +.681 at seven years to +.442 at eight years, increases at 11 years and decreases again at 12 years. It reaches the maximum + .698 at 14 years and then decreases to + .402 at 17 years. With the girls, the coefficient drops from + .433 at seven years to + .351 at 11 years, then increases to + .538 at 14 years, followed by a decrease. The averages of the coefficients are + .575 for boys and + .425 for girls.

(14) *Breathing Capacity-Sitting Height.* The correlation coefficients between the yearly measurements of breathing capacity and sitting height are very much like those between breathing capacity and standing height, though slightly lower. They are higher than the coefficients of correlation between breathing capacity and the five other physical traits.

For the boys, the coefficient decreases from +.843 at seven years to + .690 at 10 years, increases to + .818 at 15 years and then drops to + .535 at 17 years. For the girls, the coefficients are very irregular, alternately high and low. The maximum coefficient is + .762 at 13 years, and the minimum is + .430 at eight years. The averages of the coefficients are +.745 for boys and +.631 for girls.

(15) *Breathing Capacity-Girth of Chest.* The correlations between the yearly measurements of breathing capacity and girth of the chest are not so high as those between breathing capacity and height, sitting height and weight.

For the boys, the coefficient drops from +.768 at seven years to + .621 at eight years, increases to + .740 at 15 years and then decreases to +. 634 at 17 years. For the girls, the coefficient increases from +.536 at seven years to +.717 at eight years, drops to + .419 at nine years, increases to + .540 at 13 years and then drops to + .439 at 17 years. The averages of the coefficients are +.690 for boys and +.500 for girls.

(16 and 17) *Breathing Capacity-Strength of Arm.* The coefficients of correlation between the yearly measurements of breathing

capacity and the strength of the arm are lower than those between breathing capacity and height, sitting height, weight and girth of the chest.

For boys, the coefficients between breathing capacity and the right and the left arm change from +.595 and +.506 at seven years, to +.523 and +.556 at nine years, increase to +.663 and +.682 at 14 years, then drop to + .428 and + .342 at 17 years. The coefficients are much more irregular from year to year for the

Chart XLIX

girls, alternately high and low. At seven years, the coefficients are +.694 with the strength of the right arm and +.572 with the strength of the left arm. There is very little correlation after 14 years. The coefficients drop to + .163 and + .120 at 17 years. The averages of the coefficients are: breathing capacity with strength of the right arm, + .569 for boys and + .420 for girls; with strength of the left arm, +.526 for boys and +.380 for girls.

(18) *Breathing Capacity-Strength of Upper Back.* The coefficients of correlation between the yearly measurements of breathing capacity and strength of upper back are lower than the correlations of breathing capacity and the other six traits for boys and for girls,

except in the case of breathing capacity and strength of the left arm.

For boys, the coefficient drops from +.559 at seven years to + .394 at nine years, increases to + .627 at 12 years, drops slightly at 13, increases again at 14 and 15, then decreases to + .354 at 17 years. For girls, the coefficient drops from + .681 at seven years to + .190 at 17 years, alternately increasing and decreasing. The averages of the coefficients are + .520 for boys and + .414 for girls.

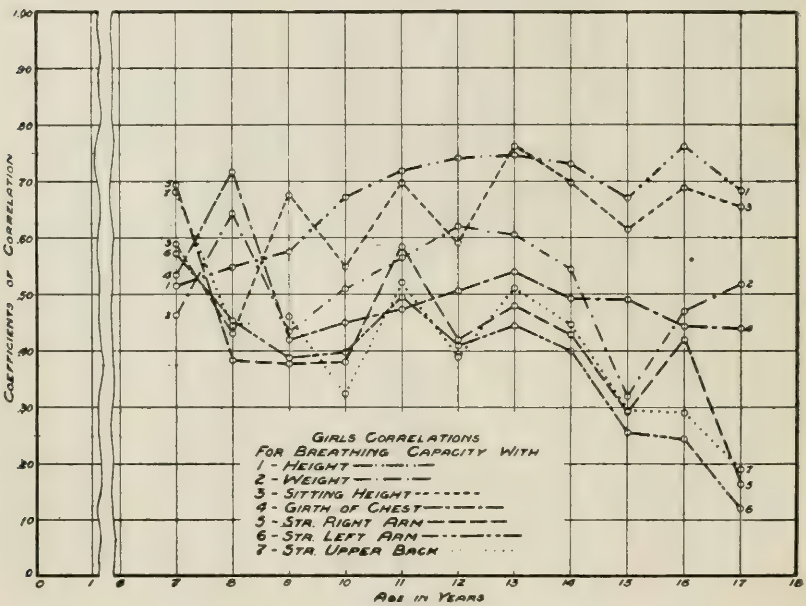


Chart L

(19) *Strength of Right Arm-Strength of Left Arm.* The correlation coefficients between the yearly measurements of strength of the right arm and strength of the left arm are uniformly high for both boys and girls. The averages of the coefficients are +.814 for boys and +.792 for girls.

There is some irregularity from the ages of seven to 11 for both sexes. Between 11 and 13 years, the coefficients are +.787 and + .797 for boys; between 14 and 17 years, they are +.843 and +.860. For girls, the coefficients vary from +.797 to +.821 between 11 and 14 years, increase to +.861 at 15 years and drop to +.642 at 17 years.

B. COLLEGE GIRLS FROM 17 TO 20 YEARS OF AGE

The physical measurements of height, weight and breathing capacity were made on 80 Swarthmore college girls annually for four years. The average height, weight and breathing capacity of the college girls at entrance were about the same as that of the 15 year old girls of the former group, but at the time of entrance to the senior year the college girls did not measure up to the standards of the 16 year old girls of the former group. There was little growth in weight and breathing capacity after the first year. The coefficients of correlation are lower than those of the other groups but follow the same general tendencies.

TABLE XVIII

CORRELATIONS FOR COLLEGE GIRLS IN HEIGHT-WEIGHT, HEIGHT-BREATHING CAPACITY AND WEIGHT-BREATHING CAPACITY

	Freshman 17 yrs.	Sophomore 18 yrs.	Junior 19 yrs.	Senior 20 yrs.
	Coef. P. E.	Coef. P. E.	Coef. P. E.	Coef. P. E.
(1). Height-Weight	+.299±.060	+.358±.066	+.351±.066	+.289±.069
(2). Height-Breathing Capacity	+.425±.062	+.502±.056	+.591±.049	+.607±.048
(3). Weight-Breathing Capacity	+.397±.064	+.389±.064	+.398±.063	+.414±.062

TABLE XIX

COMPARISON OF NORMS FOR THE CORRELATION GROUP OF GIRLS AGES 15, 16 AND 17, WITH 80 SWARTHMORE COLLEGE WOMEN

Traits	Correlation Group, by Ages			College Women, by Classes			
	15	16	17	Freshman	Sophomore	Junior	Senior
Weight	53.40	55.38	55.70	52.96	54.66	54.88	55.07
Height	159.71	161.55	161.75	159.56	160.04	160.33	160.82
Breath. Cap.	28.44	29.92	30.40	27.53	29.04	29.31	29.50
Right arm	30.39	32.29	32.18	24.80	27.04	27.26	28.94

2. ANALYSIS OF CORRELATED TRAITS:

Frequently in total correlations between physical traits, other traits are influential, making the coefficients of correlation higher or lower than they otherwise would be. These extraneous variables

may be brought under control or kept constant by the method of partial correlations. In these partial correlations the third, or constant trait, is enclosed in parentheses and the coefficient is for the other variables. The Kelly tables have been used with the original data and the Pearson formula.*

1. From Table XX it will be observed that the partial coefficients of correlation are lower than the total correlations. For height and weight, with sitting height constant, there is a slight positive correlation, which is relatively uniform with a decrease after 11 years. For height and sitting height, with weight constant, there is a decrease in the correlation, *i. e.*, growth in weight affects but very little the relationship between growth in height and sitting height. Between weight and sitting height, with height constant, there is little or no correlation, with a tendency toward a positive correlation after 11 years of age.

2. For height and weight, with breathing capacity constant, there is a positive correlation, with a decrease with age. When weight is constant, *i. e.*, if children grew tall and thin, the weight remaining the same, the correlation between height and breathing capacity would be comparatively low, (+.35 at seven and +.32 at 16 years of age.) If height remains constant, the correlation between weight and breathing capacity would be low.

3. If the chest girth remains constant, the coefficient between height and weight would still remain high, with a decrease with age, as is true with the correlation between height and weight. If the weight were to remain constant, then the correlation between height and girth of chest is negligible, or nearly 0. If height is constant, the correlation between weight and girth of chest is slightly reduced, but still high.

4. If the strength of the right arm were to remain constant, the correlation between height and weight would remain about the same as with total correlation between height and weight. If the weight were constant, the correlation between height and strength of right arm would be approximately 0. If height were constant, the correlation between weight and strength of right arm is slightly decreased.

5. For height and weight, with strength of left arm constant, the correlation is high, *i. e.* keeping strength of left arm constant has little effect on the relationship between growth in height and weight.

* In this work the writer was assisted by Gladys Fairbanks, A. M.

TABLE XX

PARTIAL COEFFICIENTS OF CORRELATION

BOYS, BY AGE

	Traits Correlated. (The constant element in each case is enclosed in parentheses)	7	8	9	10	11	12	13	14	15	16	17	Av.
1	Height-Weight (Sitting Height)	.466	.482	.399	.460	.455	.373	.262	.526	.362	.127	.422	.394
	Height-Sitting Height (Weight)	.869	.756	.801	.766	.752	.818	.787	.624	.732	.642	.628	.743
	Weight-Sitting Height (Height)	—.406	.084	.159	.106	.396	.093	.262	.232	.227	.493	.174	.165
2	Height-Weight (Breathing Capacity)	.641	.767	.712	.705	.684	.511	.547	.705	.444	.351	.532	.599
	Height-Breathing Capacity (Weight)	.351	.493	.528	.414	.371	.478	.392	.338	.485	.323	.198	.397
	Weight-Breathing Capacity (Height)	.351	.110	.069	.174	.227	.303	.356	.278	.402	.550	.403	.293
3	Height-Weight (Girth Chest)	.724	.788	.752	.675	.731	.649	.743	.692	.543	.345	.473	.646
	Height-Girth Chest (Weight)	—.240	—.361	—.021	.019	—.321	—.260	—.420	—.155	—.041	.188	—.085	.153
	Weight-Girth Chest (Height)	.768	.757	.533	.592	.809	.818	.843	.750	.767	.695	.809	.740
4	Height-Weight (Strength Right Arm)	.828	.674	.808	.753	.753	.697	.605	.797	.697	.551	.580	.704
	Height-Strength Right Arm (Weight)	—.176	.061	.073	.169	.145	.093	.214	.009	—.082	.023	.066	.054
	Weight-Strength Right Arm (Height)	.499	.546	.317	.305	.318	.348	.430	.409	.582	.551	.442	.431
5	Height-Weight (Strength Left Arm)	.863	.788	.803	.792	.775	.715	.671	.782	.712	.605	.625	.739
	Height-Strength Left Arm (Weight)	—.286	—.035	.204	.105	.126	.036	.173	.248	—.111	—.236	.153	.034
	Weight-Strength Left Arm (Height)	.523	.425	.204	.277	.290	.350	.343	.202	.585	.762	.226	.380
6	Height-Weight (Strength Upper Back)	.807	.840	.843	.792	.736	.673	.681	.806	.777	.661	.651	.751
	Height-Strength Upper Back (Weight)	—.113	—.158	.090	.061	.182	.178	.162	—.076	—.283	—.162	—.017	.012
	Weight-Strength Upper Back (Height)	.490	.368	.178	.324	.311	.306	.331	.473	.619	.477	.314	.381
7	Height-Breathing Capacity (Sitting Height)	—.044	.349	.360	.446	.195	.336	.163	.257	.290	.159	.207	.247
	Height-Sitting Height (Breathing Capacity)	.883	.813	.862	.866	.822	.816	.820	.743	.703	.663	.691	.789
	Breathing Capacity-Sitting Height (Height)	.427	.134	.065	—.068	.260	.127	.298	.326	.354	.442	.236	.236
8	Height-Breathing Capacity (Chest Girth)	.556	.648	.682	.538	.539	.602	.584	.518	.606	.393	.273	.539
	Height-Chest Girth (Breathing Capacity)	.270	.239	.373	.435	.392	.108	.072	.455	.258	.311	.344	.296
	Breathing Capacity-Chest Girth (Height)	.465	.305	.177	.274	.299	.516	.527	.314	.415	.484	.472	.386
9	Height-Breathing Capacity (Strength R. Arm)	.722	.633	.744	.603	.616	.686	.553	.634	.715	.557	.419	.625
	Height-Strength R. Arm (Breathing Capacity)	.019	.475	.337	.330	.374	.171	.368	.204	.071	.192	.279	.256
	Breathing Capacity-Strength R. Arm (Height)	.397	.100	.076	.266	.168	.263	.281	.374	.396	.310	.257	.262
10	Height-Breathing Capacity (Strength L. Arm)	.764	.694	.723	.666	.654	.710	.590	.598	.728	.569	.461	.650
	Height-Strength L. Arm (Breathing Capacity)	—.053	.217	.411	.291	.382	.127	.196	.305	.158	.146	.249	.220
	Breathing Capacity-Strength L. Arm (Height)	.370	.217	.098	.168	.069	.249	.406	.337	.262	.331	.179	.244
11	Height-Breathing Capacity (Strength U. Back)	.715	.762	.781	.657	.570	.652	.628	.659	.775	.643	.488	.666
	Height-Strength U. Back (Breathing Capacity)	.204	—.121	.267	.233	.342	.132	.292	.257	.147	—.090	.094	.159
	Breathing Capacity-Strength U. Back (Height)	.242	.398	.026	.260	.286	.390	.205	.257	.476	.395	.259	.290
12	Weight-Breathing Capacity (Sitting Height)	.336	.252	.196	.345	.266	.381	.326	.232	.418	.439	.421	.336
	Weight-Sitting Height (Breathing Capacity)	.484	.585	.672	.646	.598	.442	.529	.595	.377	.468	.421	.528
	Breathing Capacity-Sitting Height (Weight)	.527	.441	.445	.267	.423	.442	.440	.415	.534	.375	.266	.416

13	Weight-Breathing Capacity (Chest Girth)	.396	.427	.496	.375	.382	.239	.323	.407	.428	.433	.161	.369
	Weight-Chest Girth (Breathing Capacity)	.714	.711	.616	.675	.802	.749	.733	.782	.745	.627	.794	.722
	Breathing Capacity-Chest Girth (Weight)	.216	.098	.138	.202	.054	.290	.224	.100	.134	.224	.254	.175
14	Weight-Breathing Capacity (Strength R. Arm)	.679	.468	.618	.508	.558	.599	.516	.579	.611	.642	.488	.569
	Weight-Strength R. Arm (Breathing Capacity)	.331	.668	.444	.416	.452	.338	.487	.382	.474	.507	.459	.450
	Breathing Capacity-Strength R. Arm (Weight)	.192	.068	.092	.274	.147	.199	.221	.282	.153	.017	.108	.159
15	Weight-Breathing Capacity (Strength L. Arm)	.725	.558	.599	.589	.609	.621	.540	.587	.673	.664	.551	.610
	Weight-Strength L. Arm (Breathing Capacity)	.325	.443	.384	.375	.454	.318	.302	.293	.548	.736	.271	.404
	Breathing Capacity-Strength L. Arm (Weight)	.110	.148	.177	.161	.047	.155	.356	.361	—.021	—.227	.123	.126
16	Weight-Breathing Capacity (Strength U. Back)	.693	.621	.686	.559	.508	.559	.607	.616	.662	.685	.551	.613
	Weight-Strength U. Back (Breathing Capacity)	.466	.178	.312	.362	.416	.256	.388	.476	.403	.284	.252	.344
	Breathing Capacity-Strength U. Back (Weight)	.035	.253	.061	.226	.274	.370	.158	.115	.127	.115	.147	.171
17	Strength R. Arm-Strength L. Arm (Height)	.848	.608	.799	.559	.683	.749	.662	.767	.773	.816	.819	.734
	Height-Strength L. Arm (Strength R. Arm)	—.107	.024	.292	.178	.182	.079	.127	.358	.152	.084	.011	.125
	Height-Strength R. Arm (Strength L. Arm)	.347	.537	.108	.424	.320	.277	.403	.089	.226	.198	.239	.228
18	Strength R. Arm-Strength L. Arm (Weight)	.797	.495	.786	.526	.653	.711	.628	.745	.664	.709	.828	.685
	Weight-Strength L. Arm (Strength R. Arm)	.035	.120	.194	.217	.209	.158	.144	.182	.290	.592	—.216	.175
	Weight-Strength R. Arm (Strength L. Arm)	.357	.636	.239	.443	.347	.293	.467	.320	.336	—.034	.502	.355
19	Strength R. Arm-Strength L. Arm (Breath. Cap.)	.817	.624	.815	.582	.726	.730	.641	.750	.756	.396	.831	.697
	Breath. Cap.-Strength L. Arm (Strength R. Arm)	—.022	.171	.253	.126	.066	.112	.320	.294	.055	.170	—.055	.135
	Breath. Cap.-Strength R. Arm (Strength L. Arm)	.370	.345	.081	.425	.326	.277	.252	.199	.381	.170	.285	.282

TABLE XXI

PARTIAL COEFFICIENTS OF CORRELATION

GIRLS, BY AGES

	Traits Correlated. (The constant element in each case is enclosed in parentheses)	7	8	9	10	11	12	13	14	15	16	17	Av.
1	Height-Weight (Sitting Height)	—.289	.492	.220	.290	—.088	.183	.130	.156	.217	.126	.296	.157
	Height-Sitting Height (Weight)	.887	.536	.777	.720	.898	.868	.876	.814	.791	.797	.652	.622
	Weight-Sitting Height (Height)	—.016	.088	.220	.205	.370	.182	.199	.269	.140	.205	.176	.177
2	Height-Weight (Breathing Capacity)	.424	.450	.531	.470	.308	.437	.369	.481	.462	.230	.315	.407
	Height-Breathing Capacity (Weight)	.357	.236	.439	.518	.584	.549	.587	.589	.621	.689	.551	.519
	Weight-Breathing Capacity (Height)	.237	.450	.095	.141	.269	.222	.244	.100	—.067	.175	.237	.191
3	Height-Weight (Girth Chest)	.231	.377	.389	.626	.430	.553	.567	.628	.557	.453	.419	.475
	Height-Girth Chest (Weight)	.094	—.030	—.125	—.400	—.234	—.306	—.324	—.366	—.364	—.246	—.132	—.221
	Weight-Girth Chest (Height)	.827	.834	.897	.885	.926	.909	.893	.870	.885	.863	.818	.873
4	Height-Weight (Strength Right Arm)	.253	.474	.542	.543	.418	.575	.466	.504	.439	.359	.522	.463
	Height-Strength Right Arm (Weight)	.710	.554	.352	.126	.418	.314	.228	.298	.185	.318	.015	.319
	Weight-Strength Right Arm (Height)	.184	.106	.147	.372	.233	.208	.448	.325	.335	.276	.301	.266
5	Height-Weight (Strength Left Arm)	.232	.527	.561	.555	.455	.572	.526	.608	.469	.450	.549	.500
	Height-Strength Left Arm (Weight)	.699	.539	.290	.136	.242	.179	.297	.160	.162	.090	—.004	.253
	Weight-Strength Left Arm (Height)	.212	.023	.157	.318	.321	.362	.250	.231	.272	.262	.222	.239

6	Height-Weight (Strength Upper Back)	.417	.554	.560	.571	.511	.609	.531	.525	.437	.385	.477	.507
	Height-Strength Upper Back (Weight)	.496	.258	.223	.225	.271	.377	.401	.317	.389	.256	.139	.304
	Weight-Strength Upper Back (Height)	.133	.194	.223	.183	.152	.073	.143	.270	.144	.277	.308	.191
7	Height-Breathing Capacity (Sitting Height)	—.072	.390	—.030	.461	.263	.645	.184	.319	.366	.453	.383	.304
	Height-Sitting Height (Breathing Capacity)	.889	.578	.793	.742	.862	.907	.841	.798	.750	.696	.557	.764
	Breathing Capacity-Sitting Height (Height)	.335	.098	.437	—.012	.119	—.394	.255	.147	.105	.128	.287	.137
8	Height-Breathing Capacity (Chest Girth)	.327	.256	.459	.591	.638	.635	.659	.651	.621	.731	.609	.561
	Height-Chest Girth (Breathing Capacity)	.346	.285	.427	.195	.230	.317	.155	.172	.004	—.026	.169	.206
	Breathing Capacity-Chest Girth (Height)	.365	.599	.140	.241	.203	.169	.297	.255	.385	.318	.243	.292
9	Height-Breathing Capacity (Strength R. Arm)	—.075	.428	.487	.607	.580	.673	.667	.655	.636	.703	.672	.548
	Height-Strength R. Arm (Breathing Capacity)	.716	.626	.399	.242	.288	.376	.326	.415	.276	.241	.140	.367
	Breathing Capacity-Strength R. Arm (Height)	.534	—.001	.114	.145	.288	.038	.122	.024	.041	.121	.025	.132
10	Height-Breathing Capacity (Strength L. Arm)	.141	.378	.488	.607	.637	.680	.677	.684	.640	.742	.677	.577
	Height-Strength L. Arm (Breathing Capacity)	.707	.539	.310	.194	.165	.321	.318	.158	.233	.080	.080	.282
	Breathing Capacity-Strength L. Arm (Height)	.304	.148	.169	.194	.273	.070	.089	.184	.046	.108	.035	.147
11	Height-Breathing Capacity (Strength U. Back)	.180	.434	.478	.625	.648	.683	.655	.645	.638	.738	.664	.580
	Height-Strength U. Back (Breathing Capacity)	.411	.271	.225	.277	.061	.393	.331	.380	.446	.306	.293	.308
	Breathing Capacity-Strength U. Back (Height)	.538	.271	.287	.068	.355	—.005	.152	.075	—.080	—.036	—.060	.143
12	Weight-Breathing Capacity (Sitting Height)	.229	.546	—.007	.260	.192	.364	.223	.113	.005	.192	.288	.217
	Weight-Sitting Height (Breathing Capacity)	.336	.295	.525	.471	.436	.513	.380	.517	.436	.293	.265	.406
	Breathing Capacity-Sitting Height (Weight)	.466	.181	.583	.346	.535	.285	.601	.536	.550	.595	.523	.472
13	Weight-Breathing Capacity (Chest Girth)	.039	—.003	.119	.271	.392	.459	.343	.265	—.267	.198	.307	.241
	Weight-Chest Girth (Breathing Capacity)	.935	.809	.914	.858	.928	.908	.871	.836	.875	.835	.807	.870
	Breathing Capacity-Chest Girth (Weight)	.320	.426	.059	—.010	—.199	—.230	—.048	.036	.462	.073	—.006	.080
14	Weight-Breathing Capacity (Strength R. Arm)	.143	.563	.320	.396	.389	.520	.447	.395	.216	.351	.504	.385
	Weight-Strength R. Arm (Breathing Capacity)	.349	.363	.320	.424	.244	.334	.500	.460	.415	.304	.330	.367
	Breathing Capacity-Strength R. Arm (Weight)	.592	.089	.241	.150	.426	.161	.146	.171	.168	.268	—.033	.216
15	Weight-Breathing Capacity (Strength L. Arm)	.229	.554	.327	.394	.412	.513	.504	.446	.244	.424	.508	.414
	Weight-Strength L. Arm (Breathing Capacity)	.367	.208	.278	.351	.305	.443	.328	.266	.345	.260	.233	.307
	Breathing Capacity-Strength L. Arm (Weight)	.434	.251	.264	.208	.305	.087	.198	.227	.152	.110	—.019	.201
16	Weight-Breathing Capacity (Strength U. Back)	.253	.554	.291	.443	.473	.547	.492	.395	.237	.400	.495	.416
	Weight-Strength U. Back (Breathing Capacity)	.182	.194	.291	.279	.082	.231	.220	.395	.316	.334	.394	.265
	Breathing Capacity-Strength U. Back (Weight)	.603	.258	.339	.152	.418	.191	.325	.223	.192	.116	—.043	.252
17	Strength R. Arm-Strength L. Arm (Height)	.648	.658	.754	.794	.735	.739	.747	.762	.845	.649	.629	.723
	Height-Strength L. Arm (Strength R. Arm)	.317	.217	.079	.103	—.006	.129	.143	—.171	.010	—.103	.007	.066
	Height-Strength R. Arm (Strength L. Arm)	.274	.364	.283	.174	.400	.266	.255	.467	.202	.416	.159	.296
18	Strength R. Arm-Strength L. Arm (Weight)	.817	.762	.772	.770	.739	.742	.749	.751	.834	.614	.607	.741
	Weight-Strength L. Arm (Strength R. Arm)	.145	.050	.098	.083	.206	.326	—.058	—.088	—.009	.068	.043	.078
	Weight-Strength R. Arm (Strength L. Arm)	.188	.287	.197	.267	.176	.082	.466	.450	.270	.303	.262	.268
19	Strength R. Arm-Strength L. Arm (Breath. Cap.)	.800	.773	.774	.800	.725	.772	.773	.760	.847	.644	.633	.754
	Breath. Cap.-Strength L. Arm (Strength R. Arm)	—.086	.261	.150	.165	.076	.132	.092	.105	.022	—.048	.023	.081
	Breath. Cap.-Strength R. Arm (Strength L. Arm)	.480	.030	.118	.095	.350	.165	.234	.201	.135	.351	.109	.206

With height constant the correlation between height and strength of left arm is negligible, or nearly 0. With height constant, the relationship between weight and strength of left arm is little affected.

6. The correlation between height and weight is little affected when the strength of upper back is kept constant. With weight kept constant, the correlation between height and strength of upper back is approximately 0, *i. e.* the growth in height independent of weight has little to do with growth in the strength of upper back. With height constant there is a higher coefficient, but not as high as the total correlation between weight and strength of upper back.

7. With sitting height constant, the relation between height and breathing capacity is decidedly lower than in the total correlation, which shows that the growth in sitting height is more closely correlated with growth in breathing capacity than is the case with growth in height. If breathing capacity is constant, there is little effect on the correlation between height and sitting height. If height is constant, the correlation between breathing capacity and sitting height is greatly reduced.

8. If chest girth is constant, the correlation between height and breathing capacity is slightly reduced. If breathing capacity is constant, the correlation between height and chest girth is considerably reduced. If height is constant, the correlation between breathing capacity and chest girth is considerably reduced.

9. When strength of right arm is constant, there is little effect on correlation between height and breathing capacity. With breathing capacity constant, the correlation between height and strength of right arm is greatly reduced. When height is constant, the correlation between breathing capacity and strength of right arm is also considerably reduced.

10. When strength of left arm is kept constant, the correlation between height and breathing capacity is reduced practically to 0, the strength tests having little effect on the correlations between other traits. With breathing capacity constant, the correlation between height and strength of left arm is reduced considerably. When height is constant, the correlation between breathing capacity and strength of left arm is greatly reduced.

11. When strength of upper back remains constant, the correlation between height and breathing capacity is unaffected. With breathing capacity constant, the correlation between height and

strength of upper back is greatly reduced. When height is constant, breathing and strength of upper back have a much lower coefficient of correlation.

12. When sitting height is constant, the correlation between height and breathing capacity is greatly reduced. When breathing capacity is constant, the correlation between weight and sitting height is somewhat reduced. When weight is constant, the correlation between breathing capacity and sitting height is somewhat reduced, also.

13. When chest girth is kept constant, weight and breathing capacity show a considerably lower correlation. With breathing capacity constant, the correlation between weight and girth of chest is very little affected. When weight is constant the relation between breathing capacity and girth of chest is considerably reduced.

14. With strength of right arm constant, the correlation between weight and breathing capacity is very little affected, being slightly reduced. If breathing capacity is constant, weight and strength of right arm show a lower correlation. When weight is constant, breathing capacity and strength of right arm show a much lower correlation.

15. Keeping strength of left arm constant, the correlation between weight and breathing capacity becomes slightly reduced. When breathing capacity remains constant, the correlation between weight and strength of left arm is somewhat reduced, especially in the earlier ages. When weight is constant, the correlation between breathing capacity and strength of left arm is much reduced.

16. If strength of upper back remains constant, the correlation between weight and breathing capacity is somewhat reduced. When breathing capacity is kept constant, the correlation between weight and strength of upper back is also slightly reduced. When weight is constant, the correlation between breathing capacity and strength of upper back is greatly reduced.

17. With height constant, the correlation between strength of right arm and strength of left arm is little affected, *i. e.* growth in height has little influence on the relationship between strength of right arm and left arm. If strength of right arm is constant, the relation between height and strength of left arm is considerably reduced. If strength of left arm is constant, the relation between height and strength of right arm is slightly reduced.

18. When weight is kept constant, the correlation between

TABLE XXII

AVERAGE PARTIAL CORRELATIONS FOR BOYS AND GIRLS FROM SEVEN TO 17 YEARS OF AGE

TRAITS		CONSTANTS								
		Average Total Correlation	Height	Weight	Breathing Capacity	Sitting Height	Girth of Chest	Strength Right Arm	Strength Left Arm	Strength Upper Back
1. HEIGHT:										
Weight	Boys	.809			.599	.394	.646	.704	.739	.751
	Girls	.603			.407	.157	.475	.463	.500	.507
Breathing Capacity	Boys	.745		.397		.247	.539	.625	.650	.666
	Girls	.669		.519		.304	.561	.548	.577	.580
Sitting Height	Boys	.901		.743	.789					
	Girls	.858		.622	.764					
Girth of Chest	Boys	.655		—.153	.296					
	Girls	.465		—.221	.206					
Strength Right Arm	Boys	.568		.054	.256				.288	
	Girls	.521		.319	.367				.296	
Strength Left Arm	Boys	.517		.034	.220			.125		
	Girls	.444		.253	.282			.066		
Strength Upper Back	Boys	.462		—.012	.159					
	Girls	.475		.304	.308					
2. WEIGHT:										
Breathing Capacity	Boys	.730	.293			.336	.369	.569	.610	.613
	Girls	.517	.191			.217	.241	.385	.414	.416
Sitting Height	Boys	.785	.165		.528					
	Girls	.588	.177		.406					
Chest Girth	Boys	.859	.740		.722					
	Girls	.895	.873		.870					
Strength Right Arm	Boys	.671	.431		.450				.355	
	Girls	.498	.266		.367				.268	
Strength Left Arm	Boys	.619	.380		.404			.175		
	Girls	.438	.239		.307			.078		
Strength Upper Back	Boys	.575	.381		.344					
	Girls	.425	.191		.265					
3. BREATHING CAPACITY:										
Sitting Height	Boys	.745	.236	.416						
	Girls	.631	.137	.472						
Chest Girth	Boys	.690	.386	.175						
	Girls	.500	.292	.080						
Strength Right Arm	Boys	.569	.262	.159					.282	
	Girls	.420	.132	.216					.206	
Strength Left Arm	Boys	.526	.244	.126				—.135		
	Girls	.380	.147	.201				.081		
Strength Upper Back	Boys	.520	.290	.171						
	Girls	.414	.143	.252						
4. STRENGTH RIGHT ARM:										
Strength Left Arm	Boys	.814	.734	.685	.697					
	Girls	.792	.723	.741	.754					

strength of right arm and strength of left arm is little affected. When strength of right arm is constant, the relation between weight and strength of left arm is much reduced. When strength of left arm is constant, the relation between weight and strength of right arm is somewhat reduced.

19. When breathing capacity is kept constant, the correlation between strength of right arm and left arm is slightly reduced. If strength of right arm is kept constant, the relation between breathing capacity and strength of left arm is greatly reduced, almost to 0. If strength of left arm is kept constant, the relation between breathing capacity and strength of right arm is somewhat reduced.

3. Conclusions

I. Of the nineteen relationships between measurements of total growth from the years seven to 17 (in height, weight, and breathing capacity) and the measurements of growth of parts (in sitting height, girth of chest, strength of right arm, left arm and upper back) the correlation coefficients are higher for boys than for girls. The only exception is the correlation between development in weight and girth of chest, where there is involved a distinct anatomical factor.

II. It will also be noted that boys not only grow very differently from girls, but that their development is decidedly more highly correlated in its varied aspects. There is a biological difference between the growth of boys and girls during these ages from seven to 17.

III. All coefficients are positive and tend to be highest during early adolescence and lowest at 17 years of age. The periods of irregular development for *individual* boys and girls are from seven to 10 years of age and during later adolescence. There is a wide range of individual differences among the boys, but a decidedly less constant and unified development among the girls. The analysis and interpretation of the growth of each series of inter-related physical traits is shown by the tabulated and graphic distribution, and the correlation coefficients give a new insight into the development of the human organism during the plastic period from childhood through adolescence.

IV. Because boys and girls show a wider range of individual distribution and because boys and girls differ more in growth from each other at the adolescent period, it has been concluded

that this is a period of irregular individual growth. The consecutive intercorrelations of the various physical traits for both sexes show this to be unfounded. The coefficients of correlation are highest during early adolescence and begin to decrease after 14 years of age.

V. The correlation coefficients expressing on the average the physical development relationship for the period from seven to 17 years of age for boys and girls rank in the following order, from highest to lowest:

Boys Rank	Girls Rank	
1	2	Height-sitting height
2	1	Weight-girth of chest
3	3	Strength of right arm-strength of left arm
4	6	Height-weight
5	7	Weight-sitting height
6	4	Height-breathing capacity
7	5	Breathing capacity-sitting height
8	9	Weight-breathing capacity
9	10	Breathing capacity-girth of chest
10	11	Weight-strength of right arm
11	13	Height-girth of chest
12	15	Weight-strength of left arm
13	16	Weight-strength of upper back
14	17	Breathing capacity-strength of right arm
15	8	Height-strength of right arm
16	19	Breathing capacity-strength of left arm
17	18	Breathing capacity-strength of upper back
18	14	Height-strength of left arm
19	12	Height-strength of upper back

VI. College girls who have had the benefit of physical training show an increase in correlated development in height and breathing capacity from the freshman to the senior year. This is due in part probably to the systematic training and athletics in which these girls participated. The coefficients are lower for college girls than for school girls.

VII. Pearson found "that as far as the correlation between weight and height is concerned, men start with a scarcely sensible advantage over women as infants and conclude as adults with an immensely less correlation than women, among whom it appears to have slightly increased, or at any rate not to have decreased." These results of consecutive measurements for eight years or more give:

Coefficients for seven year old boys +.872 and girls +.559
Coefficient for 17 year old boys +.680 and girls +.547.

The specific conclusions derived from the partial correlations are outlined on pages 137 to 139. The general conclusions are:

VIII. Growth in weight for boys and girls has little effect on growth in height and sitting height, but does materially affect the growth of girth of chest, and also the development of strength, especially for boys.

IX. Growth in height for boys and girls has little effect on the growth of circumference of chest, but does materially affect growth in weight, sitting height and development of strength, especially for the girls.

X. Growth in breathing capacity has a decided effect on the growth of the other traits except sitting height.

4. Practical Applications

It is not the purpose of this section of the scientific *Study* to attempt to indicate many practical applications. These will follow in abundance after the fundamental principles of growth have been formulated and studied, but a few obvious educational corollaries may be cited from the preceding basic conclusions:

(1) Since girls and boys show inherent sex differences in total and partial growth, and in the relationships of these at all ages from seven to 18, girls should have different forms of physical training and different forms of directed play from boys;

(2) A careful analytic study of the periods of growth of boys and girls should precede any provisions for their physical education, and the results of such study will throw light on their development in general motor coördination, and in the mental traits which accompany, directly and indirectly, rhythmic or irregular physical development;

(3) There should be a graduated series of adjustable school desks in accordance with the general laws of physical development and individual differences in boys and girls.

5. Studies in Correlations for Individual Boys and Girls

After answering the question of how the physical traits correlate with each other from year to year as shown by repeated measurements on the same individuals, the problem arises, What correlations exist during the development of an individual? What are the sex differences?

TABLE XXIII

COEFFICIENTS OF CORRELATION

Coefficients of Correlation Based on 11 Consecutive Measurements Taken during the Period from 10-15 Years of Age for Height and Weight with Eight Other Anthropometric Traits of Six Boys and Six Girls.*

Spearman formula: $r = 1 - \frac{6 \Sigma g}{n^2 - 1}$

	Six Boys						Six Girls						Ranking Order	
Standing Height and	I	II	III	IV	V	VI	I	II	III	IV	V	VI	Boys	Girls
Sitting Height	1.00	1.00	.94	1.00	.90	1.00	1.00	1.00	1.00	1.00	1.00	.93	1	1
Weight	.95	1.00	.88	1.00	.90	.88	1.00	1.00	.98	1.00	.71	.78	2	3
Lung Capacity	.78	.95	.79	.94	.71	.82	.85	.98	.98	.91	.62	.70	4	4
Girth Chest	.80	.90	.76	.73	.81	.70	.93	.80	1.00	.58	.62	.53	5	6
Girth Hips	.85	1.00	.88	.88	1.00	.88	1.00	1.00	.98	1.00	.90	.85	3	2
Girth Thigh	.80	.89	.82	.94	.43	.76	.85	.90	.90	1.00	.43	.70	6	5
Girth Upper Arm	.75	.15	.73	.82	.86	.76	.70	.68	.85	.94	.43	.43	8	8
Breadth Shoulders	.45	.81	.82	.94	.71	.76	.33	.80	.68	.91	.71	.80	7	7

	Six Boys						Six Girls						Ranking Order	
Weight and	I	II	III	IV	V	VI	I	II	III	IV	V	VI	Boys	Girls
Standing Height	.95	1.00	.88	1.00	.90	.88	1.00	1.00	.98	1.00	.71	.78	1.5	3
Sitting Height	.95	1.00	.94	1.00	.81	.88	1.00	1.00	.98	1.00	.71	.80	3	2
Lung Capacity	.73	.95	.67	.94	.62	.82	.85	.98	.95	.91	.52	.70	6	5
Girth Chest	.75	.90	.82	.73	.90	.76	.93	.80	.98	.58	.90	.70	5	6
Girth Hips	.85	1.00	1.00	.88	1.00	.88	1.00	1.00	1.00	1.00	.81	.93	1.5	1
Girth Thigh	.80	.89	.94	.94	.52	.88	.85	.90	.93	1.00	.62	.88	4	4
Girth Upper Arm	.75	.15	.73	.82	.76	.64	.70	.68	.88	.94	.52	.60	8	8
Breadth Shoulders	.45	.81	.76	.94	.62	.79	.33	.80	.65	.91	1.00	.83	7	7

*Washington Friends' School

a. *Type Cases.* In order to determine what the individual coefficients (self correlations) are and in order to find out whether or not this is a profitable field for inquiry, six boys and six girls from the Washington Friends' School, who have been measured consecutively from eight to eleven times between the ages of ten and 15 have been selected and the coefficients between height and weight and seven other traits have been found by the Spearman formula.

b. *Conclusions*

I. The results show that: From 10 to 15 years of age for both boys and girls there are very high positive correlations between growth in height and weight and growth in sitting height, girth of chest, girth of hips, girth of thigh, girth of upper arm, breadth of shoulders and lung capacity.

II. Standing height correlates highest with sitting height for both boys and girls.

III. Weight correlates highest with standing height and girth of hips for boys and with girth of hips for girls.

IV. Standing height and weight correlate lowest with the girth of upper arm for both boys and girls.

c. *Applications.* These coefficients for growth give a synoptic picture of how individuals vary in growth from 10 to 15 years of age, and show the need of a series of norms for all ages which the writer is now working out. This group of twelve children represent rather irregular development, due to racial, social, nutritional, educational and sex conditions.

6. Correlations Between Physical Measurements at Nine or 10 Years of Age and Six Years Later

This group of correlations was made in order to determine whether children maintain their relative positions in growth, especially before and after pubescence.

a. *Type Cases.* The four traits of growth in height, weight, breathing capacity and strength (of right arm) have been chosen as indicative of general growth of 138 type cases. Is the short child at nine or 10 still a short child after six years, when growth has largely been completed? Is the relative status of the other physical traits unchanged after six years of growth? The high correlations (self correlations) provide an affirmative answer to these questions.

TABLE XXIV

CORRELATIONS BETWEEN PHYSICAL MEASUREMENTS AT SIX YEARS OF AGE AND SIX YEARS LATER

		No. of cases	Correlation Coefficient	Rank Method	Mean at Age 6	Mean at Age 12	Standard Dev at Age 6	Standard Dev at Age 12
Height	Boys	36	.728±.053	.85	117.81	149.01	5.19	9.18
in centimeters	Girls	77	.807±.027	.82	116.95	150.53	4.59	6.47
Weight	Boys	36	.821±.037	.79	21.51	39.74	2.97	7.57
in kilograms	Girls	77	.779±.030	.79	20.82	41.42	2.68	7.45
Breathing Capacity	Boys	36	.572±.076	.52	12.00	24.12	2.44	4.44
in deciliters	Girls	77	.468±.060	.46	10.72	22.66	2.02	3.10
Strength of Right Arm	Boys	36	.585±.074	.60	11.38	25.62	2.92	5.11
in kilograms	Girls	77	.268±.071	.25	10.73	24.19	2.20	3.96

TABLE XXV

CORRELATIONS BETWEEN PHYSICAL MEASUREMENTS AT NINE AND 10 YEARS OF AGE AND SIX YEARS LATER

		No. of cases	Correlation Coefficient	Mean at 9 or 10 yrs.	Mean 6 yrs. later	Standard Dev. at 9 or 10 yrs.	Standard Dev. 6 yrs. later
Height	Boys	44	.921±.015	136.50	168.82	8.04	9.40
in centimeters	Girls	94	.718±.034	134.90	160.50	5.93	6.14
Weight	Boys	44	.817±.034	30.27	56.66	5.33	9.16
in kilograms	Girls	94	.623±.043	30.35	53.94	5.40	7.29
Breathing Capacity	Boys	41	.816±.035	18.72	37.99	3.29	8.27
deciliters	Girls	92	.725±.033	16.64	28.91	2.17	4.54
Strength of Right Arm	Boys	44	.647±.059	20.27	44.09	4.27	9.96
kilograms	Girls	90	.448±.057	17.22	34.47	2.83	4.76

b. *Conclusions*

I. There is a high correlation between boys' and girls' height at six years of age and six years later, with little sex difference and also between nine or 10 and six year later, with higher coefficients for the boys.

II. The coefficients show that there is a great probability that a tall boy or girl at six years of age will be a tall boy or girl at 12 years of age; a tall boy or girl at nine or 10 will be tall at 15 or 16 years of age, *i. e.* under the conditions obtaining in the first group studied, the height of the boys or girls may be predicted at the age of 12 from the height at six years of age by a regression formula with a probable error of estimate of from three to four centimeters.

III. The heavy boy or girl at six or at nine or 10 will be a heavy boy or girl six years later, and the boy or girl with a large breathing capacity at six or at nine or 10 will have a large breathing capacity six years later; while this is also highly probable with girls, there is a greater chance for variation than with boys. It is apparent that other factors enter into the development of strength. Boys have higher coefficients of correlation except for height at six and 12 years of age.

IV. For the periods at the beginning and end of the selected intervals the boys are superior to the girls in actual measurements, but for other ages within the interim the girls are superior to the boys. The growth curves of girls cross those of boys, but this does not change the relative position of an individual within his or her group.

V. The standard deviations increase with age.

c. *Applications.* These coefficients have direct application to anticipating child development from the physical, mental or social point of view, for they show that one can prophesy with a considerable degree of accuracy the physical development of a boy or girl at 16 years of age, providing the development is known at 10 years of age, and at 12 years of age, providing the development is measured at six years of age. His or her future development correlates highly with his or her earlier development after six years of age in a graded series from development in height to development in strength. These results apply directly to vocational guidance, school training, social activities and periods of maturation.

TABLE XXVI

COEFFICIENT OF VARIATION = $100 \frac{\sigma}{m}$

For Eight Physical Traits from Seven to 17 Years of Age. Boys. Girls.

			7	8	9	10	11	12	13	14	15	16	17
Height	Cms.	Boys	5.923	4.932	5.669	5.388	5.242	4.929	5.166	5.796	5.273	4.408	3.933
		Girls	4.248	4.107	4.259	4.650	5.122	5.426	5.141	4.871	4.320	4.209	4.080
Weight	Kgms.	Boys	17.529	13.776	15.642	15.719	16.247	16.051	16.479	17.752	15.844	12.918	11.500
		Girls	13.620	13.519	17.657	18.147	18.335	20.279	19.917	17.463	15.730	14.806	15.978
Breath. Cap.	Decil.	Boys	23.239	17.182	18.416	17.907	18.181	17.922	16.775	21.613	19.338	16.852	15.348
		Girls	23.430	19.305	15.477	15.578	15.667	21.676	16.532	15.564	14.767	14.705	14.144
Sitting Height	Cms.	Boys	5.759	4.430	5.178	4.919	4.932	4.679	5.340	5.882	5.548	5.059	4.067
		Girls	4.564	6.799	4.361	4.770	4.757	5.422	5.452	5.157	4.412	3.867	3.865
Girth Chest	Cms.	Boys	7.625	5.780	6.207	6.010	7.065	6.571	7.508	7.518	7.518	5.341	5.583
		Girls	5.850	5.351	7.147	7.801	7.963	7.985	8.460	7.235	6.794	6.468	6.214
St. Right Arm	Kgms.	Boys	30.182	27.702	23.688	18.715	16.062	18.923	16.949	21.101	20.845	17.274	17.226
		Girls	30.276	20.392	22.598	18.949	17.500	17.719	13.866	14.930	14.149	14.865	12.430
St. Left Arm	Kgms.	Boys	28.985	23.947	23.543	20.374	17.587	18.258	20.008	19.572	21.636	17.268	16.859
		Girls	27.777	18.518	22.556	17.421	19.371	18.669	16.211	16.576	16.631	14.352	12.713
St. Upper Back	Kgms.	Boys	35.763	35.107	27.777	29.885	26.472	27.341	24.507	25.781	28.051	22.572	22.745
		Girls	38.523	30.872	30.000	23.297	22.906	22.916	22.235	21.681	20.124	22.232	18.148

7. Coefficients of Variability

When an absolute measure of variability as the standard deviation in inches or centimeters, pounds or kilograms, is divided by the average, a relative measure is obtained which is called the coefficient of variation, which is a pure number whereas the standard deviation involves various units of measurement. In making comparisons of the groups with respect to this variability, allowance can be made for the fact that the amount of central tendency influences the size of the S. D. that is obtained.

The discovery of the variability of a species or a class of organisms lies at the basis of the evolution of the species or class and is the determinant in tracing the factors of natural selection and inherent growth of the individuals.

A. GROUP I.

(1) *Data.* Pearson found that male infants at birth are more variable in height and weight than females, and he also found that from six to 10 years of age, females are more variable than males in both height and weight. For the 120 children from seven to 17 years of age, where repeated annual measurements have been made from six to 10 years on each child, the results here are contra-

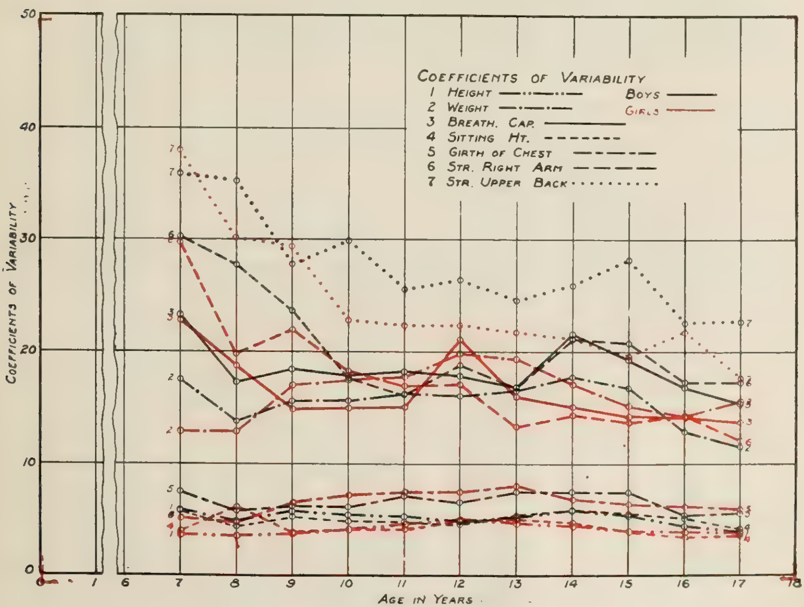


Chart LI

dictory to Pearson's for height and also for weight -at the years seven, eight, nine, 10, 11, 13, 14, 15, and 16 for height, and at seven, eight, 14, 15, for weight. For results see Table XXVI.

(2) *Conclusions*

I. For height boys have a greater variability than girls at all ages between seven and 17, except at 12 and 17; at 13 they are the same. Boys fluctuate more in variability in height than girls.

II. For weight boys have greater variability except at the ages of nine to 13, inclusive, and at 16 and 17. Girls also fluctuate more in variability in weight than boys.

III. For breathing capacity the boys are more variable than the girls at all ages except seven, eight and 12.

IV. The variability for sitting height is greater for boys at all ages except at eight, 12 and 13.

V. For chest girth, the variability is the same as for weight, the boys being more variable except from nine to 13, inclusive, and at 16 and 17.

VI. For strength of right arm, the variation for boys is greater for all ages except seven, 10 and 11, and the more variable ages for girls for the left arm are 11 and 12.

VII. The variability in strength of upper back for boys is greater than for girls, except at the ages of seven and nine.

TABLE XXVII

COEFFICIENTS OF VARIATION = $100 \frac{\sigma}{m}$

FOR FOUR PHYSICAL TRAITS AT SIX YEARS OF AGE AND SIX YEARS LATER AND AT NINE OR 10 AND SIX YEARS LATER. BOYS AND GIRLS

Traits		Age 6	Age 12	At 9 or 10	6 yrs. later
Height	Boys	4.41	6.16	5.89	5.56
	Girls	3.92	4.30	4.39	3.82
Weight	Boys	13.81	19.05	17.58	16.17
	Girls	12.87	17.99	17.78	13.52
Breathing Capacity	Boys	20.31	18.39	17.55	21.77
	Girls	18.83	13.66	13.03	15.69
Strength of Right Arm	Boys	25.66	19.95	21.04	22.59
	Girls	20.50	16.37	16.42	13.80

VIII. These results show boys to be more variable in height and weight than Pearson (576) found and also Bowditch (113), who, in turn, found them more variable than did Boas and Wissler (100).

B. GROUP II.

(1) *Data.* In order to find the coefficient of variability for the same children for consecutive years, a group of 115 boys and girls whose measurements were taken at six years of age and consecutively for six years later, was used, and another group of 138 boys and girls of nine or 10 years of age, with consecutive measurements for six years. The results in Table XXVII show the following:

(2) *Conclusions*

I. Boys are more variable than girls at six years of age and six years later, also at nine or 10 and six years later.

II. For weight the girls are more variable at six years of age and six years later; at nine or 10, the variability is approximately the same, and six years later boys are more variable.

III. For breathing capacity boys are more variable at six years of age and six years later, and also at nine or 10 and six years later.

IV. For strength of right arm boys are more variable at six years of age and six years later, and also at nine or 10 and six years later.

V. Pearson also states that "both sexes lose not only variability, but correlations as they grow older." This statement is too general.

VI. Many of the coefficients of correlations increase with age, practically all increasing from nine or 10 to 14 years of age, the same holding true for the coefficients of variability for height, weight, and breathing capacity at 13 or 14 for boys and for girls. In the strength tests, the variations decrease in general with age, with a rise at 15 years of age.

VII. For the ages from nine or 10 and six years later, there is a decrease in the coefficient of variation for height and weight for boys and girls.

VIII. In breathing capacity there is an increase in variability for both boys and girls for these ages.

IX. In strength of right arm there is an increase in variability for boys and a decrease for girls for these ages.

C. GROUP III

(1) *Data.* For the group of 80 college girls whose measurements were followed throughout the four years of college, the results show:

TABLE XXVIII

COEFFICIENTS OF VARIATION = 100 $\frac{\sigma}{m}$
FOR FOUR PHYSICAL TRAITS FOR 80 SWARTHMORE COLLEGE GIRLS

Traits	Freshman	Sophomore	Junior	Senior
Height	3.67	3.55	3.44	3.52
Weight	16.43	15.89	16.01	17.13
Breathing Capacity	14.66	14.36	13.33	13.12
Strength of Right Arm	16.04	23.00	15.66	15.06

(2) *Conclusions*

I. The results for the eighty college girls from 17 to 21 years of age show a lower coefficient of variation than for girls from seven to 17 years of age, with a slight drop from the freshman year to the senior year.

II. The coefficient of variation for college girls for weight is lower than for the ages nine to 14 years, but higher than for 15, 16 and 17 years of age.

III. In breathing capacity there is a gradual decrease in the coefficient of variation for the college girls from the freshman to the senior year, and a lower coefficient than for any of the other ages previous to 17 years.

IV. For strength of right arm, the college girls show in general a coefficient of variability similar to the previous group after 13 years of age, the sophomore college girls being almost as high as the seven year old girls of the previous group.

8. GROWTH NORMS FOR GROUP USED FOR CORRELATIONS

a. *Data.* In order to compare the group of Horace Mann boys and girls whose correlations have been expressed in Tables XVI and XVII with larger groups and with those from other schools, the averages of the individual for the eight traits used in the 19 series of correlations from seven to 18 years of age are expressed in Table XXIX.

The yearly records include 10,560 yearly measurements based on

semi-annual examinations for eight years or more on the same individuals, or approximately 60,000 measurements.

Standard Weight-Height-Age and Height-Breathing Capacity-Age Tables for all of the normal standard children included in

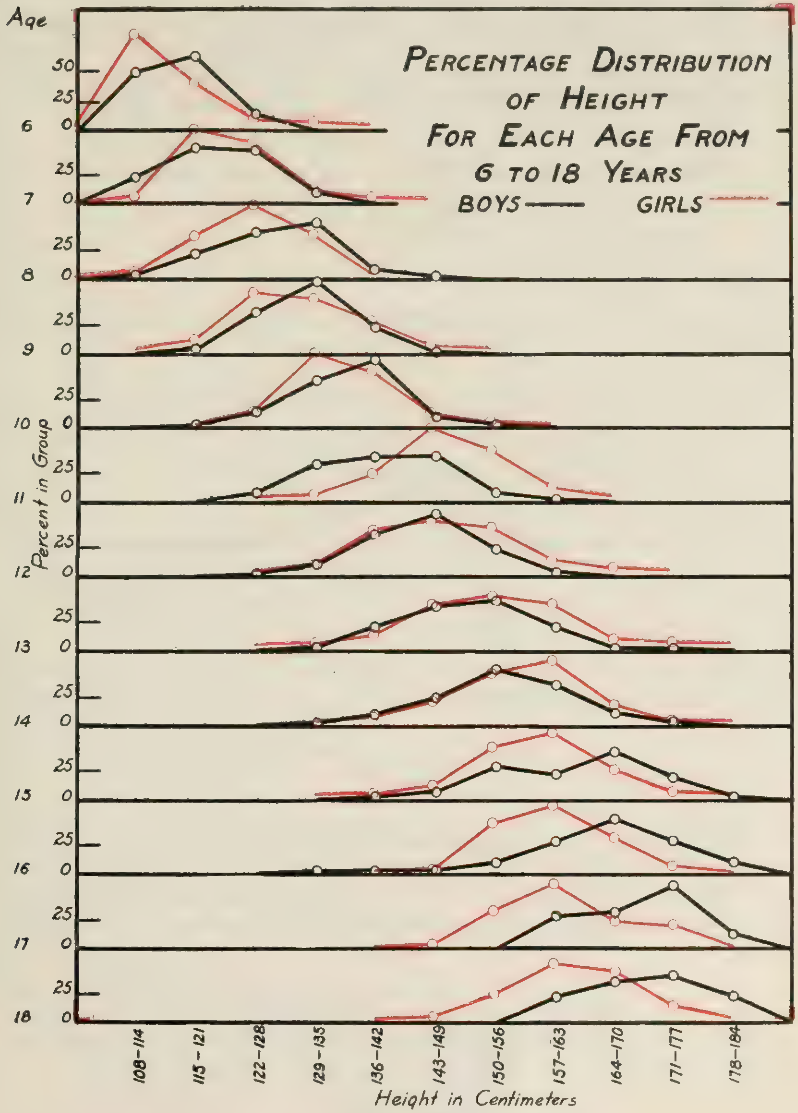
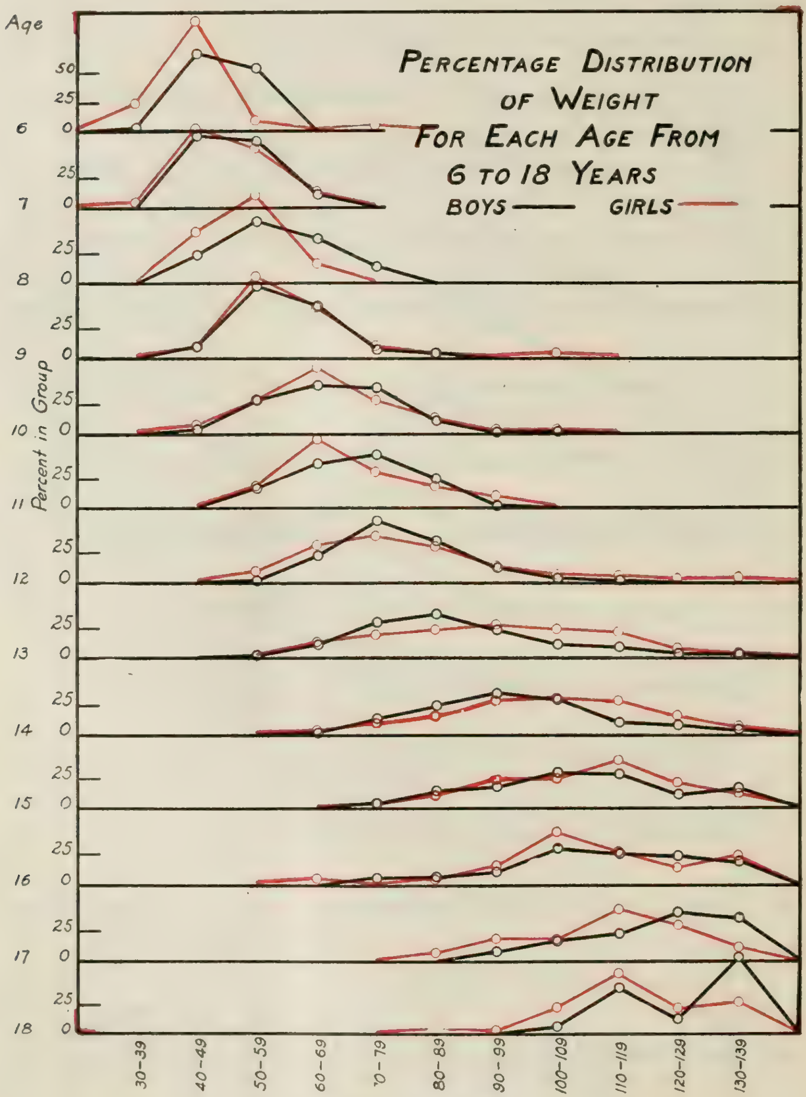


Chart LII

this *Study* have been worked out and will be published in the form of a separate Table and Practical Score Card.



Weight in Pounds

Chart LIII

b. *Conclusions*

These results are typical for height, weight and breathing capacity and almost identical when compared with the previous norms for larger groups in the 1914 Bulletin and the new ones on page 152. The means for the other five traits are also very similar to the norms in the Supplement. It will be noted that:

I. Girls are taller than the boys from 10 to 14 years of age.

II. Girls are heavier than boys from nine to 16 years of age.

III. Girls are inferior to boys in breathing capacity for all ages.

IV. Girls are superior to boys in sitting height from 10 to 16 years of age.

V. Girls are superior to boys in chest girth from 12 to 15 years of age.

VI. Girls are inferior to boys in strength of right and left arms and upper back at all ages.

VII. For normal children between seven and 17 years of age, these results may be considered as normal average standards.

c. *Applications.* As normal standards these averages, their deviations, the yearly increments, the indices and the annual percents of gain may be used for evaluating the growth of groups of American children within these age limits. The norms, which are among the highest in the world, show what school medical inspecton, physical training and directed play can do for children; for many of these boys and girls were sickly or under-nourished when small and several are Hebrews, who are racially of small stature and small features.

9. Mean Deviations in Growth of Correlation Groups

a. *Data.* In studying the comparative growth of a number of individuals for consecutive chronological ages, the mean deviations are important on account of showing the distribution of individuals within the groups. The mean deviations are shown in Table XXX.

b. *Conclusions*

I. The girls show higher mean variations than the boys at 12 and 13 years of age in height, lower at the other ages between seven and 18.

II. The mean variations for girls in weight and sitting height are higher for all ages from eight to 18 years.

TABLE XXIX

NORMS FOR GROUPS FOR EACH YEAR FOR EIGHT TRAITS WITH EIGHT YEARS OR MORE OF REPEATED MEASUREMENTS.

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
A Height	Boys	121.56	125.70	130.72	135.47	140.27	144.81	150.96	156.99	163.14	169.24	172.87
(in centimeters)	Girls	120.04	124.16	129.13	135.48	140.57	145.58	151.72	156.01	159.71	161.55	161.75
B Weight	Boys	22.87	24.68	27.49	29.90	32.62	35.51	40.05	44.50	49.86	54.96	59.13
(in kilograms)	Girls	22.76	24.41	27.75	31.41	34.36	37.97	43.68	48.10	53.40	55.38	55.70
C Breathing Capacity	Boys	12.92	14.55	16.29	17.87	19.80	21.76	24.44	27.76	32.06	36.79	40.51
(in deciliters)	Girls	11.95	12.95	14.86	16.69	18.51	20.76	23.59	25.70	28.44	29.92	30.40
D Sitting-Height	Boys	65.98	67.71	69.52	71.15	72.98	74.79	77.30	79.90	83.02	86.97	88.51
(in centimeters)	Girls	65.72	66.18	68.78	71.27	73.57	75.61	78.86	81.44	83.86	85.32	85.38
E Chest Girth	Boys	59.01	60.55	62.83	64.89	66.52	68.48	71.92	74.48	78.47	82.37	85.96
(in centimeters)	Girls	58.11	59.80	62.96	65.37	67.81	70.13	74.46	77.40	80.95	81.93	82.07
F Strength Right Arm	Boys	12.59	14.80	17.73	19.77	21.79	23.78	27.73	30.33	35.02	41.68	45.28
(in kilograms)	Girls	11.23	13.24	15.93	18.47	20.00	22.01	25.24	28.13	30.39	32.29	32.18
G Strength Left Arm	Boys	11.73	13.78	16.14	18.16	19.90	21.36	24.49	28.10	31.89	37.64	39.74
(in kilograms)	Girls	10.08	11.88	14.63	17.22	19.10	20.89	23.44	25.94	28.26	29.96	29.89
H Strength Upper Back	Boys	7.27	8.83	11.16	13.05	15.11	17.19	20.81	23.66	27.45	32.34	36.49
(in kilograms)	Girls	6.23	7.45	9.00	11.16	12.66	14.40	16.64	18.91	20.87	22.04	22.04

TABLE XXX

MEAN DEVIATIONS FOR GROUP IN TABLE XXIX

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
A Height	Boys	6.00	5.17	6.09	6.02	6.08	5.79	6.34	7.03	6.95	6.59	5.72
(in centimeters)	Girls	4.21	4.02	4.37	5.02	5.75	6.13	6.36	6.25	5.84	5.87	5.67
B Weight	Boys	2.80	2.64	3.38	3.83	4.47	4.44	5.25	6.39	6.40	5.90	5.38
(in kilograms)	Girls	2.43	2.65	3.85	4.55	5.10	6.07	6.82	6.58	6.44	6.24	6.65
C Breathing Capacity	Boys	2.35	2.02	2.31	2.44	2.86	3.14	3.27	4.49	4.67	4.96	4.85
(in deciliters)	Girls	2.26	2.03	1.89	2.11	2.26	2.93	3.09	3.29	3.40	3.68	3.53
D Sitting-Height	Boys	3.38	2.49	2.88	2.84	2.88	2.70	3.15	3.59	3.75	3.42	2.75
(in centimeters)	Girls	2.51	3.00	2.47	2.74	2.86	3.29	3.46	3.50	2.99	2.76	2.75
E Chest Girth	Boys	3.19	2.67	3.32	3.25	3.68	3.65	4.42	4.52	4.94	3.61	3.79
(in centimeters)	Girls	2.66	2.41	3.63	4.17	4.30	4.46	4.82	4.23	4.24	3.99	3.74
F Strength Right Arm	Boys	3.09	3.40	3.49	3.11	2.80	3.52	3.57	5.01	5.89	5.45	6.23
(in kilograms)	Girls	2.92	2.18	2.76	2.82	2.87	3.04	2.96	3.36	3.34	3.60	3.33
G Strength Left Arm	Boys	2.64	2.63	3.02	2.82	2.80	3.22	3.83	4.33	5.50	5.09	5.23
(in kilograms)	Girls	2.23	1.94	2.61	2.45	3.03	3.14	3.19	3.06	3.74	3.38	2.82
H Strength Upper Back	Boys	2.09	2.58	2.61	3.00	2.96	3.88	4.16	5.00	6.00	6.20	6.72
(in kilograms)	Girls	1.85	1.91	2.15	2.20	2.31	2.57	3.10	3.43	3.41	3.78	3.11

III. Girls also have a higher mean variation in chest girth from nine to 17 years of age.

IV. Girls have a lower mean variation for all ages in breathing capacity.

V. Girls have lower mean variations in strength of right arm, left arm and upper back for all ages from seven to 18 years.

VI. In every trait except in weight and chest girth the boys show a wider range of distribution for these ages.

VII. The greatest mean variations for both boys and girls are during the characteristic adolescent ages for each; the smallest are during the earlier periods from seven years to nine years of age.

10. Yearly Increments of Growth of Group in Table XXIX

a. *Data.* The actual annual increments of yearly growth are significant for this group as shown in Table XXXI. "A study of the individual measurements in height reveals different correlations in growth for boys and girls above the median from those below. That is, the rhythms of fluctuations of growth for tall children differ materially from those for short children. This is demonstrated by the norms found, which serve in this connection as a temporary expedient for estimating the relative heights of the children and as a means for dividing them into two general groups, those lying on and above the median and those lying below the median. There are some who cross the median, and others whose curves fluctuate toward or from the median. Those lying above the median height begin and end their periods of acceleration and arrest earlier than those below the median." For increment data see former monograph (27), pages 30 and 31. For new norms for tall and short girls see table XXXVI pages 165 and 166.

"As will be noted, the results give the greatest absolute increment and the greatest average deviations during the adolescent period, beginning at 12 years of age for boys above the median height and beginning at 10½ years for the girls above the median. This marked acceleration continues until 15½ for boys and until 13 for girls. For those below the median height the greatest average acceleration begins at 14 years for boys, and at 11½ years for girls, and continues, for the boys, until 17½ and for the girls until 15½.

TABLE XXXI

INCREMENTS OF GROUP IN TABLE XXIX FOR ONE YEAR PERIODS FROM SEVEN TO 17 YEARS OF AGE

		7-8 yrs.	8-9 yrs.	9-10 yrs.	10-11 yrs.	11-12 yrs.	12-13 yrs.	13-14 yrs.	14-15 yrs.	15-16 yrs.	16-17 yrs.
A Height	Boys	4.14	5.02	4.75	4.80	4.54	6.15	6.03	6.15	6.10	3.63
(in centimeters)	Girls	4.12	4.97	6.35	5.09	5.01	6.14	4.29	3.70	1.84	.20
B Weight	Boys	1.81	2.81	2.41	2.72	2.89	4.54	4.45	5.36	5.10	4.17
(in kilograms)	Girls	1.65	3.34	3.66	2.95	3.61	5.71	4.42	5.30	1.98	.32
C Breathing Capacity	Boys	1.63	1.74	1.58	1.93	1.96	2.68	3.32	4.30	4.73	3.72
(in deciliters)	Girls	1.00	1.91	1.83	1.82	2.25	2.83	2.11	2.74	1.48	.48
D Sitting Height	Boys	1.73	1.81	1.63	1.83	1.81	2.51	2.60	3.12	3.95	1.54
(in centimeters)	Girls	1.46	2.60	2.49	2.30	2.04	3.25	2.58	2.42	1.46	.06
E Chest Girth	Boys	1.54	2.28	2.06	1.63	1.96	3.44	2.56	3.99	3.90	3.59
(in centimeters)	Girls	1.69	3.16	2.41	2.44	2.32	4.33	2.94	3.55	.98	.14
F Strength Right Arm	Boys	2.21	2.93	2.04	2.02	1.99	3.95	2.60	4.69	6.66	3.60
(in kilograms)	Girls	2.01	2.69	2.54	1.53	2.01	3.23	2.89	2.26	1.90	—.11
G Strength Left Arm	Boys	2.05	2.36	2.02	1.74	1.46	3.13	3.61	3.79	5.75	2.10
(in kilograms)	Girls	1.80	2.75	2.59	1.88	1.79	2.55	2.50	2.32	1.70	—.07
H Strength Upper Back	Boys	1.56	2.33	1.89	2.06	2.08	3.62	2.85	3.79	4.89	4.15
(in kilograms)	Girls	1.22	1.55	2.16	1.50	1.74	2.24	2.27	1.96	1.17	.00

"The rhythms and fluctuations of growth in height for the children above the median show that these boys and girls mature in physiological growth earlier than those below the median, since their periods of acceleration and arrest begin earlier and end earlier. There are individual measurements lying on either side of these medians, arranged in all probability in a normal distribution from the tallest to the shortest for each chronological age. If this is the case, as the individual curves will show, we are justified in making averages or medians only when the average or norm is based on the physiological age instead of the chronological age. A new and very important educational problem is evoked here: How may we formulate a measuring scale for determining the physiological age of the child? A careful study of individual growth curves, based on consecutive measurements, it is hoped, will help to answer this question" (27).

b. *Conclusions*

I. In yearly increments of growth there are not only sex differences, but a wide range of differences for each trait at various ages.

II. The increments are higher in the case of girls than of boys as follows: from nine to 13 years of age for weight; from 11 to 13 years of age for breathing capacity; from eight to 13 years of age for sitting height; from eight to 13 years of age for chest girth; from eight to 13 years of age for strength of left arm. They are inferior at all other ages for all traits and for these ages (eight to 13) for strength of right arm and upper back.

11. Yearly Percent of Gain From Seven to 14 Years of Age

This table is significant in that it shows the annual increase in increment in growth for the eight physical traits under consideration. The yearly gains in percent can be best gleaned from Table XXXII. It should be noted that

I. For growth in height the yearly increment of percent is very uniform for boys from seven to 16, with a short rise from 12 to 13 years of age; for girls from seven to 13 the yearly increment of percent is very uniform, with the rise from 12 to 13 and a cessation after this age.

II. For growth in weight there is a higher percentage increment

Table XXXII

YEARLY PERCENT OF GAIN FROM SEVEN TO 17 YEARS OF AGE

Ages		7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	Average
A. Height	Boys	3.4	3.9	3.6	3.5	3.2	4.2	3.3	3.9	3.7	2.1	3.48
(in centimeters)	Girls	3.4	4.0	4.9	3.7	3.5	4.2	2.8	2.3	1.1	.1	3.00
B. Weight	Boys	7.9	11.3	8.7	9.0	8.8	12.7	11.1	12.0	10.2	7.5	9.92
(in kilograms)	Girls	7.2	13.6	13.1	9.3	10.5	15.0	10.1	11.0	3.7	.5	9.40
C. Breathing Capacity	Boys	12.6	11.9	9.6	10.8	9.8	12.3	13.5	15.4	14.7	10.1	12.07
(in deciliters)	Girls	8.3	14.7	12.3	10.9	12.1	13.6	8.9	10.6	5.2	1.6	9.82
D. Sitting Height	Boys	2.6	2.6	2.3	2.5	2.4	3.3	3.3	3.9	4.7	1.7	2.93
(in centimeters)	Girls	2.7	3.9	3.4	3.2	2.7	4.2	3.2	2.9	1.7	.07	2.60
E. Chest Girth	Boys	2.6	3.7	3.2	2.5	2.9	5.0	3.5	5.3	4.9	4.3	3.79
(in centimeters)	Girls	2.9	5.2	3.8	3.7	3.4	6.1	3.9	4.5	1.2	.1	3.48
F. Strength Right Arm	Boys	17.5	19.7	11.5	10.2	9.1	16.6	9.3	15.4	19.0	8.6	13.69
(in kilograms)	Girls	17.8	20.3	15.9	8.2	10.0	14.6	11.4	8.0	6.2	—.3	11.21
G. Strength Left Arm	Boys	17.4	17.1	12.5	9.5	7.3	14.6	14.7	13.4	18.0	5.5	13.00
(in kilograms)	Girls	17.8	23.1	17.7	10.9	9.3	12.2	10.6	8.9	6.0	—.2	11.63
H. Strength of Upper Back	Boys	21.4	26.3	16.9	15.7	13.7	21.0	13.6	16.0	17.8	12.8	17.52
(in kilograms)	Girls	19.5	20.8	24.0	13.4	13.7	15.5	13.6	10.3	5.6	0	13.64

for all ages up to 13 years for boys, with more irregularity than for the previous traits outlined, and with the peak of increase between 12 and 13.

III. For breathing capacity the percentage increase is a little higher and more irregular than for height. The girls are higher than the boys until 13 years with no definite peak period.

IV. The lowest annual increase in percent is in sitting height for boys and girls, and the highest in strength of upper back. This is also shown graphically in the profile charts, pages 111, 112, 113 and 114. For sitting height the annual percent of gain is lower for the boys than for girls until 12 years of age.

V. Growth in chest girth, which is also lower for boys until 14 years of age, is also small and more variable than for sitting height.

VI. and VII. For strength of the arms the annual increase is a little higher than for the previous traits, with variations for the two arms and for boys and girls, the boys increasing more on the average than the girls.

VIII. For upper back there is a greater annual increase than for other traits, but there is so much variation that no definite age stands out prominently, the boys growing more on the average than the girls.

12. Indices of Growth of Group in Table XXIX

a. *Data.* As previously emphasized, the relationship between the growth of two physical traits which may be expressed as an index, is more significant than is the growth of either. The importance of the index or coefficient of robustness (the weight-height coefficient) is outlined in Part IV and this index should form the normal standard of growth in place of either height or weight. Table XXXIII gives the average indices of all ages and for each sex. There is little or no apparent difference, as a rule, between the tall boys and the short boys, except that the tall individuals have high indices early. This clearly substantiates the important conclusions previously stated that the development of any normal physiological change in the traits measured occurs earlier for tall children. For data see Figs. 1 to 29 and pages 30 to 71 in the earlier monograph (27).

TABLE XXXIII

AVERAGE INDICES OF GROWTH OF GROUP IN TABLE XXIX

		7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
Weight-Height Index	Boys	.188	.196	.210	.221	.233	.245	.265	.283	.306	.325	.342
		(1.05)*	(1.10)	(1.17)	(1.24)	(1.30)	(1.37)	(1.48)	(1.58)	(1.71)	(1.82)	(1.81)
	Girls	.190	.197	.215	.232	.244	.261	.288	.308	.334	.343	.344
		(1.06)	(1.10)	(1.20)	(1.30)	(1.36)	(1.46)	(1.61)	(1.72)	(1.87)	(1.92)	(1.92)
Vital-Height Index	Boys	.106	.116	.125	.132	.141	.150	.162	.177	.197	.217	.234
	Girls	.100	.104	.115	.123	.132	.143	.155	.165	.178	.185	.188
Sitting Height-Height Index	Boys	.543	.539	.532	.525	.520	.516	.512	.509	.509	.514	.512
	Girls	.547	.533	.533	.526	.523	.519	.520	.522	.525	.528	.528
Chest Girth-Height Index	Boys	.485	.482	.481	.479	.474	.473	.476	.474	.481	.487	.497
	Girls	.484	.482	.488	.483	.482	.482	.491	.496	.507	.507	.507
Strength Right Arm-Height Index	Boys	.104	.118	.136	.146	.155	.164	.184	.193	.215	.246	.262
	Girls	.094	.107	.123	.136	.142	.151	.166	.180	.190	.200	.199
Strength Left Arm-Height Index	Boys	.097	.110	.123	.134	.142	.148	.162	.179	.195	.222	.230
	Girls	.084	.096	.113	.127	.136	.143	.154	.166	.177	.185	.185
Strength Upper Back-Height Index	Boys	.060	.070	.085	.096	.108	.119	.138	.151	.168	.191	.211
	Girls	.052	.060	.070	.082	.090	.099	.110	.121	.131	.136	.136

*English measure

That the weight-height indices vary with different nationalities can be demonstrated by selecting weight and height tables from Part V. Take for example Erismann, Baldwin, Pagliani, Bobbitt and Misawa. From eight to 15 years of age the indices for the Russians increase for the boys from .201 to .361; for the Americans from .196 to .306; for the Italians from .175 to .275; for the Filipinos from .174 to .268; and for the Japanese from .168 to .265. That is, the Russians and Americans are heavier for their stature than are the other nationalities represented.

b. *Conclusions*

(1) WEIGHT-HEIGHT INDEX

I. The weight-height index is the most practical criterion of normal growth in robustness and, other conditions being normal, in general nutrition.

II. The weight-height indices increase from six to 18 years of age on the average 100 percent, which shows that weight increases more proportionately than height.

III. A well-developed tall or short child approaches within 15 per cent of the weight-height index for the chronological age to which the child's height corresponds.

IV. For tall boys and tall girls the coefficient for the weight-height is in advance chronologically of that for the mean or average and the reverse holds true for short children. The tall heavy children are older physically.

V. In interpreting and evaluating the seven series of indices for each age for each sex, it should be noted that the weight-height indices for girls are higher at all ages, which means the girls are proportionally heavier for their height than boys.

(2) VITAL-HEIGHT INDEX

I. The vital-height index is a good criterion of the respiratory height relationship.

II. The vital-height index more than doubles for boys during the ages from six to 18 years and nearly doubles for girls, which shows that in growth in breathing capacity boys increase proportionately more than in growth in height.

III. The vital-height index is higher for the boys than for the girls at all ages, which shows that boys have greater breathing capacity for their heights than girls.

IV. A well developed tall or short child should approach within 15 per cent of the vital-height index for the chronological age to which the child's height corresponds.

V. For tall boys and tall girls the coefficient for the vital-height is in advance chronologically of that for the mean or average and the reverse holds true for short children.

(3) SITTING HEIGHT-HEIGHT INDEX

I. The sitting height indices for boys and girls show on the average a slight decrease from six to 16 years of age, and for boys from six to 13 years of age, which shows that standing height is increasing more proportionately at these ages than height-sitting.

II. Girls maintain a relatively higher sitting height-height relationship than boys.

(4) CHEST GIRTH-HEIGHT INDEX

I. Chest girth-height indices change little from seven to 13 years of age, with a slight drop for ages from 11 to 15.

II. Girls have a slightly higher index than boys. After 13 the index is considerably higher for girls.

(5) STRENGTH OF RIGHT ARM-HEIGHT INDEX

I. The strength of right arm-height indices increase on the average steadily from six to 18 years to more than 100 percent for boys and approximately 100 percent for girls, which shows that the strength of the right arm increases more proportionately than the stature.

II. In the strength-height relationships for right arm the boys are invariably superior.

(6) STRENGTH OF LEFT ARM-HEIGHT INDEX

I. The strength of left arm-height indices increase on the average steadily from six to 18 years to more than 100 percent for boys and approximately 100 percent for girls, which shows that the strength of the left arm increases more proportionately than the stature.

II. The indices for the left arm are uniformly lower with this group of children than those for the right.

III. In the strength-height relationships for left arm the boys are invariably superior.

(7) STRENGTH OF UPPER BACK-HEIGHT INDEX

I. The indices for growth of strength in upper back increase more from six to 18 than any of the other indices. For the boys

this increase is nearly 300 percent, for the girls about 250 percent.

II. Boys increase most during the ages from 14 to 18 and girls increase least after 15 years of age.

III. In the strength-height relationships for upper back the boys are invariably superior.

13. Percent of Increase Between Seven, 12, and 17 Years of Age

a. *Data.* What percent of a boy's or girl's growth at 17 years of age has he or she reached at seven years of age, and at 12 years of age? Do boys and girls grow more between seven and 12 years of age or between 12 and 17 years of age? These are very important questions from many standpoints for individuals and the problems are analyzed further by a study of individual growth curves. The averages as given in Table XXXIV and XXXV will answer the question in a general way and will show the group tendencies.

Table XXXIV

PERCENT OF INCREASE BETWEEN SEVEN, 12 AND 17 YEARS OF AGE

Traits		At 12 yrs.	At 17 yrs.	Between 7 and 12 yrs.	Between 12 and 17 yrs.
Height	Boys	119%	142%	19%	23%
	Girls	121	135	21	14
Weight	Boys	155	259	55	104
	Girls	167	245	67	78
Breathing Capacity	Boys	168	314	68	146
	Girls	174	254	74	80
Sitting Height	Boys	113	134	13	21
	Girls	115	130	15	15
Girth of Chest	Boys	116	146	16	30
	Girls	121	141	21	20
Strength of Right Arm	Boys	189	360	89	171
	Girls	196	287	96	91
Strength of Left Arm	Boys	182	339	82	157
	Girls	207	297	107	90
Strength of Upper Back	Boys	236	502	136	266
	Girls	231	354	131	123

TABLE XXXV

PERCENT OF FINAL GROWTH AT 17 YEARS OF AGE THAT HAS BEEN ATTAINED AT SEVEN AND 12 YEARS OF AGE

Traits		At 7 yrs.	At 12 yrs.	Between 7 and 12 yrs.	Between 12 and 17 yrs.
Height	Boys	70.3%	83.8%	13.5%	16.2%
	Girls	74.2	90.0	15.8	10.0
Weight	Boys	38.7	60.1	21.4	39.9
	Girls	40.9	68.2	27.3	31.8
Breathing Capacity	Boys	31.9	53.7	21.8	46.3
	Girls	39.3	68.3	29.0	31.7
Sitting Height	Boys	74.5	84.5	10.0	15.5
	Girls	77.0	88.6	11.6	11.4
Girth of Chest	Boys	68.6	79.7	11.1	20.3
	Girls	70.8	85.5	14.7	14.5
Strength of Right Arm	Boys	27.8	52.5	27.4	47.5
	Girls	34.9	68.4	33.5	31.6
Strength of Left Arm	Boys	29.5	53.7	24.2	46.3
	Girls	33.7	69.9	36.2	30.1
Strength of Upper Back	Boys	19.9	47.1	27.2	52.9
	Girls	28.3	65.3	37.0	34.7

		7 yrs.	12 yrs.	17 yrs.
Sitting Height to Standing Height	Boys	54.3%	51.6%	51.2%
	Girls	54.7	51.9	52.8

b. *Conclusions*

I. Girls have completed at seven years of age on the average in each of the eight physical traits: height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm, and strength of upper back, a higher percent of their final development (at 17) than have boys.

II. Girls gain between seven and 12 years of age a greater percent of their final growth (at 17) than do boys, in all of the eight traits: height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm, and strength of upper back.

III. From 12 to 17 years of age, girls gain a higher percent than boys in sitting height, chest girth, strength of right arm, left arm and upper back.

IV. Boys and girls both gain a higher percent from 12 to 17 years of age in the other traits of weight and breathing capacity.

V. The girls at seven years of age have reached a stage of development considerably in advance of that of boys, and girls continue this lead in all phases of growth, so that a 12 year old girl is as far advanced toward her final growth at 17 as a 14 year old boy.

VI. The direct percent of sitting height to standing height at seven, 12 and 17 is almost identical for boys and girls. The ratio is approximately 1-2 being slightly below this at seven years of age.

VII. Girls grow more proportionally than boys from seven to 12 years of age in height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm. Boys gain slightly more in strength of upper back.

VIII. Boys grow more proportionally than girls from 12 to 17 years of age in height, weight, breathing capacity, sitting height, girth of chest, strength of right arm, strength of left arm and strength of upper back.

14. Norms for Tall and Short Girls

These norms for girls above or below median height show that on an average the tall girls surpass the short girls in all of the eight physical traits outlined. They also show that tall girls grow differently than short girls. These norms supplement those on page 152 but include more cases.

TABLE XXXVI

NORMS FOR TALL AND SHORT GIRLS, WITH STANDARD DEVIATIONS

GIRLS	AGE	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11
Average														
A. Height	Tall	111.3	113.0	116.4	119.5	122.3	125.6	128.4	131.3	133.3	137.2	138.6	142.2	145.1
	Dev.	1.37	1.83	3.0	2.6	1.97	2.23	1.96	2.51	2.18	2.64	2.69	2.82	3.3
	Short	102.4	107.1	109.0	113.0	114.4	117.9	119.7	122.3	125.2	126.9	130.0	132.8	135.1
	Dev.	1.38	1.51	2.1	2.2	3.43	2.37	2.08	2.71	2.84	2.17	3.06	3.29	3.7
B. Weight	Tall	18.8	19.9	20.8	22.2	23.0	25.0	26.1	28.2	28.5	31.6	32.4	35.0	35.5
	Dev.	1.87	1.47	1.1	1.5	1.64	2.59	2.72	3.08	2.83	3.24	4.08	4.56	5.4
	Short	15.8	16.2	18.2	18.8	19.5	20.9	21.8	22.7	24.2	25.3	27.4	29.1	30.3
	Dev.	1.27	2.68	1.5	1.6	1.82	1.82	2.04	1.62	2.56	2.11	3.28	3.74	5.4
C. Breathing Capacity	Tall	8.6	9.4	10.7	11.2	12.1	13.5	13.5	15.3	15.8	17.1	17.1	18.8	19.2
	Dev.	1.47	1.07	.82	.72	11.2	1.30	1.20	1.43	1.27	1.62	1.24	1.67	1.84
	Short	5.1	7.7	9.7	10.1	9.9	11.3	11.8	13.0	13.1	14.3	15.0	16.1	16.7
	Dev.	.98	1.20	1.4	.67	6.77	1.39	1.27	1.02	1.16	1.20	1.47	1.70	1.65
D. Sitting Height	Tall	60.6	62.3	63.3	64.8	65.5	67.4	68.4	69.6	70.2	71.9	72.2	73.8	75.0
	Dev.	1.51	1.9	1.7	1.7	2.09	1.52	1.36	1.54	1.7	1.78	1.62	1.63	1.9
	Short	56.2	59.6	59.8	62.1	61.8	63.9	64.4	66.0	66.5	67.9	68.7	70.1	71.1
	Dev.	.28	2.2	7.8	2.5	2.21	1.41	1.87	1.38	1.6	1.56	1.96	2.35	2.3
E. Girth of Chest.	Tall	55.5	57.1	57.3	59.2	59.1	61.2	61.6	64.1	63.3	66.3	67.4	68.5	69.1
	Dev.	9.0	1.5	1.2	2.5	1.97	3.02	1.88	3.15	2.86	3.62	4.42	3.81	4.8
	Short	52.9	53.5	54.3	55.9	55.4	57.2	57.6	58.6	60.4	61.0	63.2	64.4	65.6
	Dev.	2.47	1.46	2.5	2.3	2.4	2.0	2.7	2.09	2.64	2.16	3.14	3.51	3.7
F. Strength of Right Arm	Tall	7.6	9.7	10.4	11.3	11.9	13.8	14.7	16.6	16.9	18.4	19.1	20.5	21.2
	Dev.	1.8	2.6	1.8	2.0	1.97	2.19	2.17	2.1	2.82	2.87	2.63	6.17	3.2
	Short	6.3	7.7	9.1	10.2	10.1	12.3	12.3	13.7	14.5	15.3	17.3	18.2	18.9
	Dev.	1.75	1.6	2.0	4.5	2.08	1.6	2.03	1.6	2.12	1.64	2.2	2.49	2.4
G. Strength of Left Arm	Tall	7.4	10.2	10.8	11.7	11.9	13.7	14.7	16.5	16.7	18.4	19.1	20.4	20.8
	Dev.	1.62	2.2	1.2	2.2	1.95	1.98	2.39	2.04	2.88	2.86	2.67	2.79	2.7
	Short	6.4	7.2	8.5	10.3	10.0	12.2	12.2	13.8	14.5	15.1	17.3	17.9	18.9
	Dev.	1.8	1.83	1.11	1.18	2.0	1.66	1.76	1.68	2.11	1.74	2.46	2.32	2.3
H. Strength of Upper Back	Tall	2.4	4.2	4.7	5.0	6.2	6.9	7.7	9.1	10.1	11.1	11.0	11.9	12.7
	Dev.	1.24	1.03	1.1	1.73	1.71	2.24	1.87	2.04	1.29	2.52	2.65	2.47	2.9
	Short	3.5	2.8	3.5	3.9	3.9	5.6	5.8	7.5	7.4	8.9	9.3	10.5	10.9
	Dev.	1.5	.64	1.	1.17	1.07	1.84	1.51	1.26	3.19	1.55	1.67	1.88	2.3

TABLE XXXVI, Continued

GIRLS	AGE	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½
Average														
A. Height	Tall	148.7	151.4	155.2	157.5	160.1	162.3	163.7	163.9	165.6	166.9	166.6	166.8	167.3
	Dev.	3.0	3.8	3.5	3.5	3.0	2.9	3.4	2.9	3.4	3.1	3.4	3.0	3.8
	Short	138.4	140.0	144.7	147.7	149.4	152.0	152.9	154.1	154.4	155.1	155.4	156.2	155.3
	Dev.	3.7	3.9	4.0	3.4	3.7	3.1	2.8	2.9	2.8	2.5	2.95	2.1	4.6
B. Weight	Tall	39.8	40.3	45.5	46.4	50.8	52.1	54.2	54.1	57.2	57.0	59.4	58.5	58.8
	Dev.	5.1	5.9	5.9	6.3	6.2	6.1	5.4	6.5	7.0	4.8	6.3	4.3	5.3
	Short	32.4	34.7	38.5	40.7	43.8	44.7	48.3	47.8	50.5	49.1	51.4	50.6	53.2
	Dev.	4.0	5.1	5.6	5.3	5.8	5.7	4.8	4.3	4.9	4.3	3.6	4.2	3.2
C. Breathing Capacity	Tall	21.4	21.6	24.7	24.8	27.2	27.3	30.1	29.0	31.1	32.1	32.1	33.8	32.1
	Dev.	2.03	2.45	2.32	2.44	2.85	2.55	2.96	3.78	3.12	3.61	4.65	2.63	4.27
	Short	18.2	18 4	21.0	21.7	23.1	24.0	25.0	25.6	26.1	25.6	26.8	27.3	26.4
	Dev.	1.93	1.98	2.14	2.09	2.68	2.86	1.85	2.67	1.90	2.46	2.13	2.46	1.32
D. Sitting Height	Tall	76.7	78.1	79.8	81.0	82.1	83.9	84.9	84.8	86.7	87.3	88.1	87.6	88.1
	Dev.	1.9	2.6	2.6	3.9	2.5	1.8	2.15	1.6	1.2	2.2	2.7	1.8	2.8
	Short	72.9	74.0	76.3	77.7	78.7	80.5	81.0	81.7	82.3	82.7	83.4	83.3	83.5
	Dev.	2.9	2.6	3.1	2.7	2.5	2.3	2.2	1.7	1.7	1.3	1.4	1.0	4.0
E. Girth of Chest	Tall	72.1	72.3	76.0	76.6	80.0	80.1	81.7	81.0	82.4	82.5	83.4	83.6	83.4
	Dev.	3.7	4.9	4.5	4.6	4.5	4.4	3.4	4.1	3.9	3.0	4.0	2.9	3.8
	Short	67.3	68.8	71.7	73.5	75.7	76.4	78.7	78.2	80.3	78.3	80.1	79.2	82.2
	Dev.	3.3	4.3	4.2	3.8	4.0	4.0	4.2	2.7	3.0	3.1	2.7	2.4	1.85
F. Strength of Right Arm	Tall	23.2	24.0	26.0	26.3	28.0	29.0	30.1	32.2	31.4	32.9	34.0	32.0	34.3
	Dev.	2.4	3.4	3.1	3.0	3.3	3.45	3.0	4.6	4.3	3.6	3.3	2.8	4.2
	Short	20.6	21.8	23.3	24.7	26.6	27.3	28.8	28.9	29.1	29.6	29.8	29.7	29.2
	Dev.	2.3	3.4	2.6	3.8	2.4	3.6	2.6	3.0	2.9	3.6	3.4	3.8	1.9
G. Strength of Left Arm	Tall	22.3	23.2	24.9	25.8	27.1	27.8	28.5	29.3	29.3	30.4	30.3	30.0	29.9
	Dev.	2.5	3.0	2.9	3.1	2.9	3.3	3.1	3.3	4.0	3.6	2.9	3.8	4.0
	Short	20.3	21.6	22.2	24.1	25.5	26.1	27.2	28.0	28.0	27.9	28.4	27.7	26.3
	Dev.	2.5	3.2	2.6	2.9	1.7	3.5	2.2	3.4	2.5	3.7	3.3	3.2	1.8
H. Strength of Upper Back	Tall	13.7	13.7	16.2	16.7	17.5	17.2	19.2	19.7	22.4	22.7	22.8	22.9	23.0
	Dev.	2.5	3.1	3.0	3.5	2.35	2.6	2.3	3.5	3.0	3.8	4.2	2.8	2.4
	Short	12.3	12.8	14.0	15.5	17.0	16.5	18.1	17.1	19.2	18.6	20.7	19.0	21.0
	Dev.	2.5	2.9	2.2										3.3

PART III

CHAPTER VII

ANATOMICAL AGE

1. The Anatomical Development of Boys and Girls

Two closely related ages which characterize a child's development quite as much as its chronological age in years, months and days, but are less understood, less commonly used, and therefore less familiar to parents and teachers, are the anatomical and physiological age. These denote the physical, or anatomical, growth and the accompanying stages of physical maturation of the individual as indicated by growth of bones, eruption of teeth, color of eyes, metabolism, marked functional changes in sex organs, changes of voice and many other phases of physiological development not so apparent to the casual observer.

Children of the same chronological age may vary greatly in their anatomical and physiological development. Since physical growth in the larger sense conditions all other aspects of development, it is essential that these ages be discussed in detail. Few scientists have attempted to differentiate between these two ages, but this is essential if a careful study is to be made of the development of childhood. An analysis of the anatomical growth of the carpal bones (the wrist) will be made, a diagnosis of the physiological age at adolescence will be outlined empirically, and some specific correlations between the two ages with applications will follow.

a. *Roentgenograms as Criteria of Anatomical Age.* In order to throw more light on the previous data on physical growth, the writer made a comparative study of the carpal bones of a group of boys between the ages of 11 and 13 and a group of girls between the ages of 10 and 13, the growth being followed for three years. These children from the seventh school grade of the University of Iowa Junior High School, are as nearly as could be determined in a preliminary way, normal children from good, representative homes, with normal school progress, as indicated by school grades, school

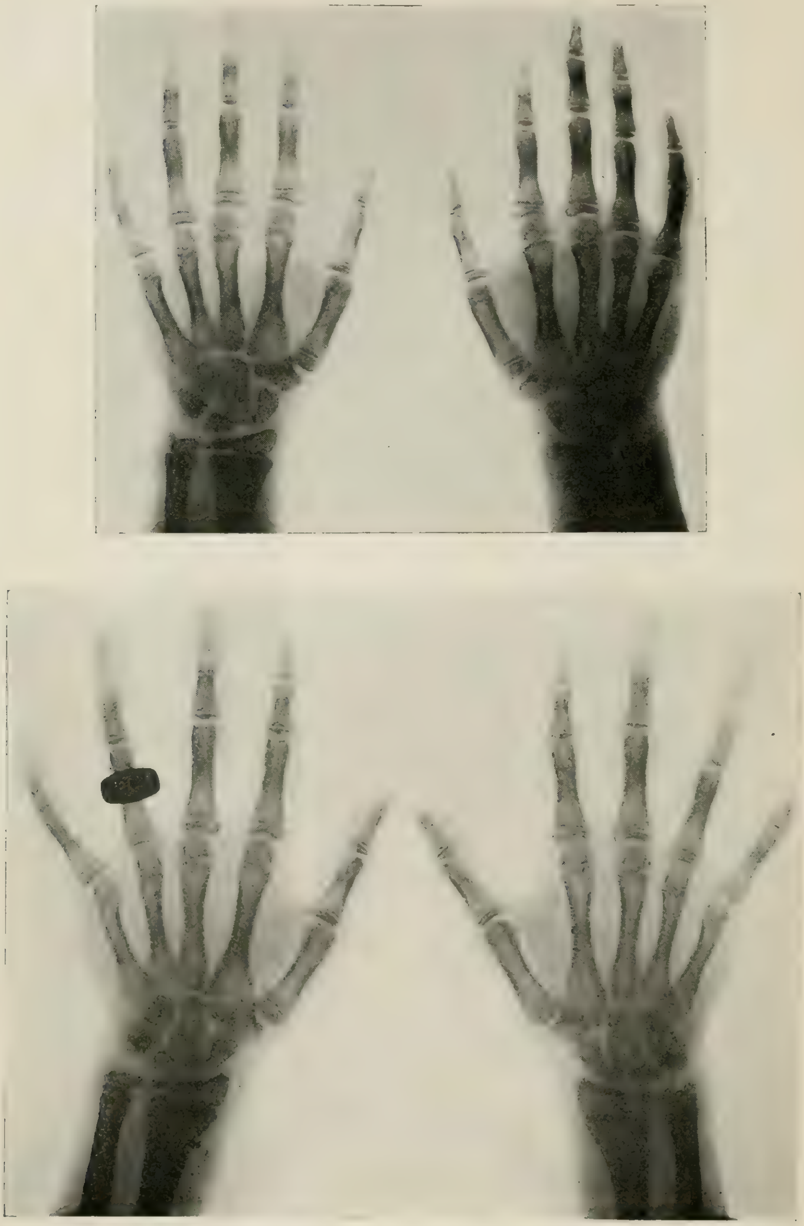
marks, and a series of mental examinations for the three consecutive years. The analyses give a good insight into the physical status of these young adolescents, since the ossification of the bones of the wrist is representative of the skeletal development in general.

The roentgenographs included in this investigation were taken in the Department of Roentgenology of the University College of Medicine by Dr. Bundy Allen. One series was taken in 1918 just before the writer was called into the U. S. Army, and another series on the same individuals after his return, and a third series in October, 1920. The roentgenograms were of the exact natural size and the two hands were placed in a uniform position as far as possible. The individual differences in the forms and positions of the carpal bones and the difficulty of differentiating between various stages as the cartilaginous tissue develops into osseous substance present distinct problems in determining the topographical area of the bones.

b. *Method of Finding the Area of the Bones of the Wrist.* At first attempts were made to measure the perimeter of the individual bones by means of a map tracer and protractors. This method was soon discarded and a method of tracing the outlines on millimeter cross section paper through an illuminated frosted glass plate was tried and also discarded. The tables in this section of the *Study* give the measurements as found by means of the planimeter (Photograph 11) with which the area of surfaces of irregular outline can be determined with accuracy. The accompanying photograph (12) shows the development at the beginning and at the end of the two year interval for one boy, No. 8376 (John) (Photograph 12). In 1918 the total exposed area of the seven bones was

Photograph 11. Planimeter: Instrument for Measuring Area of Carpal Bones

Photograph 12. Comparative Study of John at 11 Years 11 Months and at 13 Years 10 Months



Photograph 13. Eldon, Aged 12 Years Five Months and 14 Years Six Months

1110 sq. mms. and just two years later, 1920, the total area was 1832 sq. mms. In this case there was marked growth in the area of each bone and in the total area also because of the appearance of the pisiform (116 sq. mms.) after the two year period.

All original X-ray photographs have been reduced in these cuts from natural size by means of a uniform scale which makes the photographs of this *Study* comparable.

Further examples of the differences in the development of the wrist bones at various ages are contained in a series of comparative observations on No. 8370 (Eldon) (Photograph 13) and No. 8376 (John) (Photograph 12) for the year 1918 showing that in physical growth No. 8376 (John) is advanced, being both taller and heavier; in the anatomical development of the seven observable bones of the wrist No. 8376 has a larger projected surface area for bones separately and for all of the bones collectively. The same differences are observable in the photographs for 1920; in physiological development No. 8376 (John) was post-pubescent in 1918 and No. 8370 (Eldon) pre-pubescent; in chronological age No. 8376 (John) is six months younger than No. 8370 (Eldon). These data demonstrate that No. 8376 (John) is the older boy anatomically, although chronologically six months the younger.

c. *Names and Description of the Carpal Bones.* In the adult there are eight carpal bones in the wrist. The first proximal row includes from the radial toward the ulnar side, the *scaphoid,** the *semilunar,* the *cuneiform* and the *pisiform;* the second row, the *trapezium, trapezoid,* the *os magnum* and the *unciform.* Exceptionally, other bones may occur. The *pisiform* of the first row is, *en masse,* practically nothing but a sesamoid bone, independent of the flexor carpi ulnaris, resting on the palmar of the cuneiform and having no share in the mechanics of the wrist except as giving attachment to a part of the anterior annular ligament. The first proximal row, therefore, consists really of the first three bones mentioned, which are joined into one flexible piece by the interosseous ligament. The upper end of this combination bears an egg-shaped articular surface for the wrist joint, to which all three bones contribute. Its lower side has a concavo-convex outline, the concavity receiving the inner two bones and the convexity bearing the outer two of the second row. The latter consists of four bones connected by liga-

* The Piersol nomenclature has been adopted in this *Study*.

ments; the *trapezium* for the thumb; the *trapezoid* and the *os magnum* for the next two fingers; and the *unciform* for the ring and little finger. The dorsal side of the carpus is slightly convex, and the palmar deeply concave, forming by its middle, the floor of a deep canal, reached by the anterior, annular ligament which runs between bony elevations on each side of the carpus. A small depression for ligaments can be seen on well-marked bones near their edges on the dorsal and palmar aspects.

(1). The *scaphoid*, or boat-shaped bone, is the largest and most external of the first row. The *scaphoid* articulates with five bones: the *radium, semilunar, trapezium, trapezoid,* and *os magnum.*

(2). The *semilunar* receives its name from its outline when seen from the side, the proximal surface being convex and the distal deeply concave. The semilunar articulates with five bones: the *radium, scaphoid, cuneiform, os magnum* and the *unciform.*

(3). The *cuneiform* is frequently called the pyramidal on account of its form. The *cuneiform* articulates with three bones: the *semilunar,* the *pisiform* and the *unciform.*

(4). The *pisiform* has just been described above, p. 171.

(5). The *trapezium* is distinguished by an isolated facet on the distal surface for the metacarpal bone of the thumb. The *trapezium* articulates with four bones: the *scaphoid, trapezoid,* and the first and second *metacarpals.*

(6). The *trapezoid* is best recognized by the dorsal surface which is pointed distally where it progresses into the second metacarpal. This bone articulates with four bones: the *scaphoid, trapezium, os magnum* and the second *metacarpal.*

(7). The *os magnum* is the largest of the carpus and possesses a head, neck and body. It articulates with seven bones: the *scaphoid, semilunar, trapezoid, unciform,* second, third and fourth *metacarpals.*

(8). The *unciform* is distinguished by a prominent hook projecting from the inner side of the palmar surface for part of the annular ligament. This bone articulates with five bones: the *semilunar, cuneiform, os magnum,* the fourth and the fifth *metacarpal.*

These bones, with the exception of the pisiform, are clearly outlined in the roentgenograms (Photograph 14) No. 13,141 (Wilbur) of the writer's son at the age of 11, given here as illustrative of preadolescent development. The total exposed area in this case is 870 sq. mm.

d. *The Development and Individual Variations in These Bones.* In early foetal life, centers appear for the above described bones, and also for many others which disappear or are fused with the usual ones long before the appearance of bones. An additional carpal depends either on the persistence and subsequent ossification

Photograph 14. Wilbur, Aged 11 Years

of centers that probably are lost, or on the separate development of two or more that fuse.

Ossification occurs from one center for each bone, but according to some authorities, the unciform and the scaphoid have two centers. The order of appearance of the first bones is not certain. The above cut (Photograph 15) No. 15,268 (Patricia) shows the development

Photograph 15. Patricia, Aged 1½ Years

of the writer's one and one-half year old girl. It will be noted that the three bones are present. Those of the proximal row, except the pisiform, are ossified by the end of the first four or five years chronologically, with a sex difference of nearly two years, the girls reaching this period first. These are followed by the trapezium and the trapezoid, so that by the eighth year the observable process has begun in all the carpals, save the pisiform, where it begins about the twelfth year. It may be noted that the seven are present in the previous case of the ten year old boy.

2. Comparative Areas for Different Ages

a. *Data for Comparative Study for 1918 and 1920.* The total areas of each of the seven bones: scaphoid, semilunar, cuneiform, trapezium, trapezoid, os magnum and unciform, for a limited number of children between 11 and 14 years of age, taken entirely at random from the University High School, are given in Table XXXVII where a direct comparison of the amount of development may be made for the two years' interval. The individuals in this Table are arranged chronologically and their respective heights, weights and individual bone areas from a dorsal view, with the increments of each, are given.

In all cases for the ninety-one bones included, there has been an increase, it will be noted, except in one instance for the scaphoid, one for the cuneiform, two for the trapezoid and one for the unciform, where there have been decreases due probably to a change in relative position.

A prominent characteristic of these 11, 12 and 13 year old boys and girls is the absence of the fifth, or pisiform, bone in all cases, except for the first subject in the 1918 series. That is, the appearance and ossification of this bone denotes an anatomical age beyond that attained by any of the individuals in this group save one. It will be noted that two years later, 1920, for three of the boys, fourth, fifth, and sixth respectively, the pisiform bone has made definite appearance, and for two of the girls, fourth and fifth respectively there has been an increase in area, although this is not very marked.

These results show in general that there is a positive correlation between the height and weight of a child, and the degree of anatomical development. Considering the area of the wrist bones, the taller, heavier boys and girls have the larger wrist areas in the

Table XXXVII

COMPARATIVE AGES, HEIGHTS, WEIGHTS, SURFACE AREAS OF THE CARPAL BONES AND STAGES OF PHYSIOLOGICAL MATURATION.

	Age at date of Radiograph		Height		Weight		Total		Trapezium		Trapezoid		Os Magnum		Unciform		Pisiform		Cuneiform		Semilunar		Scaphoid		Physiological Maturation
BOYS	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	1918	1920	
8372	11-7	13-6	139.2	150.5	34.9	48.5	1052	1355	129	142	97	116	290	329	206	226			97	129	90	187	142	226	Pubescence
8375	11-7	13-9	152.4		37.5		1271	1587	148	206	116	142	297	361	206	226			135	181	161	206	206	265	Postpubescence–
8381	11-9	13-11	141.2		33.5		942	1535	97	148	65	135	265	342	174	252			116	226	84	155	142	277	Prepubescence
8376	11-11	13-10	146.5		37.6		1110	1832	123	181	116	142	290	413	187	265		116	142	168	116	200	135	348	Postpubescence
8370	12-5	14-6	139.2		34.9		936	1348	103	174	65	90	232	265	187	232		90	90	135	116	155	142	206	Prepubescence–
8374	12-7	14-7	141.0	155.4	32.8	44.4	961	1284	110	148	71	123	277	303	181	194		77	116	116	90	129	116	194	Prepubescence
8378	12-11	14-11	147.6	168.5	34.0	55.5	1374	1826	116	196	116	142	329	413	226	303			168	219	194	200	226	355	Pubescence
8377	13-9	15-8	143.9	156.3	34.2	44.4	845	1129	71	84	45	71	219	297	155	239			84	90	129	123	142	226	Prepubescence
GIRLS																									
8426	11-3	13-3		144.3		36.1	1155	1510	155	168	129	135	232	342	206	252			77	181	148	161	206	271	Pubescence
8424	11-4	13-5		153.7		39.35	1155	1239	135	155	84	84	290		206				116		135		187		Prepubescence
8429	12-6	14-6		163		47.0	1090	1342	129	129	97	135	297	290	252	232	110	116	129	129	187	245	271	277	Postpubescence
8428	12-10	15-1		160.7		55.79	1503	1594	161	168	84	90	290	323	148	219	71	97	84	135	135	148	148	200	Pubescence
8425	14-2	16-3		151.8		42.64	1174	1387	146	168	90	123	252	310	200	213			148	174	148	148	194	252	Prepubescence

TABLE XXXVIII

HEIGHT, WEIGHT AND EXPOSED AREA OF CARPAL BONES

Boys No.	Age	Height	Weight	1 Trapezium		2 Trapezoid		3 Os Magnum		4 Unciform		5 Pisiform		6 Cuneiform		7 Semilunar		8 Scaphoid		Totals		
				L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L&R
16283	8-1	137	33	40	50	40	40	200	210	180	150			90	100	60	80	40	40	650	670	1320
16294	8-3	128.5	27.8	10	10	40	50	190	200	110	120			80	70	70	60	40	50	540	560	1100
16236	8-10	134	29.7	110	110	90	70	260	250	110	130			90	90	110	100	100	110	870	860	1730
16293	9-2	122	24.9	10	10	30	40	130	110	120	110			80	70	50	70	40	30	460	440	900
16296	9-2	127.5	28.3	60	50	40	40	160	150	120	130			100	90	90	80	80	70	650	610	1260
16233	9-3	140.4	30.8	60	40	70	80	230	230	150	170			80	90	90	120	50	60	730	790	1520
16290	9-5	135.7	32.5	100	110	70	70	220	230	120	140			110	100	110	120	110	120	840	890	1730
16220	10-4	152.5	49.5	100	100	80	50	210	240	120	150	40	40	90	120	100	140	90	130	830	970	1800
16222	10-8	143.5	35.5	150	130	100	80	270	240	170	190			110	100	110	110	150	170	1060	1020	2080
16237	10-9	136.6	33	90	130	80	60	260	260	230	170			110	150	130	130	140	170	1040	1070	2110
16214	10-10	139.9	31	40	60	30	30	190	210	140	140			80	90	40	60	90	90	610	680	1290
16239	10-10	134.9	27.2	70	80	60	60	170	130	180	140			80	90	30	20	3	30	593	550	1143
16280	10-11	140	31.7	100	100	90	70	210	230	180	150			120	130	120	110	110	110	930	900	1830
16206	11-0	134.4	28	60	80	70	90	240	250	210	190			110	100	110	120	110	100	910	930	1840
16291	11-3	127.6	31.5	120	110	60	70	210	220	190	180			110	110	110	110	100	110	900	910	1810
16216	11-4	147.8	44.3	110	90	80	60	250	230	210	190			100	110	110	120	110	90	970	890	1860
16215	11-6	141	30.1	110	90	60	80	230	240	250	220			110	110	110	100	120	100	990	940	1930
16235	11-6	140	28.5	100	120	90	80	250	270	190	150			110	130	110	100	90	120	940	970	1910
16285	11-7	140.4	32.1	110	100	90	100	210	210	180	190			100	110	90	100	110	120	890	930	1820

Continued on next page

TABLE XXXVIII, Continued

16208	11-10	147.5	40.7	130	130	80	90	260	240	180	160			140	120	110	90	100	120	1000	950	1950
16212	12-8	140	34	80	90	60	70	190	160	140	120			90	80	90	90	70	60	720	670	1390
16234	12-9	159	62.1	170	170	130	90	260	280	200	240	90	80	140	140	150	190	280	270	1420	1460	2880
16213	13-5	143.3	32	160	170	120	100	290	280	210	190			140	160	170	180	240	230	1330	1310	2640
																				19873	19970	39843
																			Average	864	868	1732

	Probable Error
Height-Area of Carpal Bones of right wrist coefficient +.879	±.0275
Weight-Area of Carpal Bones of right wrist coefficient +.755	±.052
Coefficient of Variation of Carpal Bones of right wrist 29.94	

TABLE XXXIX

HEIGHT, WEIGHT AND EXPOSED AREA OF CARPAL BONES

GIRLS No.	Age	Height	Weight	1 Trapezium L	1 Trapezium R	2 Trapezoid L	2 Trapezoid R	3 Os Magnum L	3 Os Magnum R	4 Unciform L	4 Unciform R	5 Pisiform L	5 Pisiform R	6 Cuneiform L	6 Cuneiform R	7 Semilunar L	7 Semilunar R	8 Scaphoid L	8 Scaphoid R	Totals L	Totals R	Totals L&R
16287	8-3	117	20.7	70	90	70	80	160	170	110	120	?	?	80	90	60	60	60	70	610	680	1290
16295	8-10	134.5	39.6	100	110	90	80	200	210	150	160			70	90	110	110	100	130	820	890	1710
16278	8-11	131.5	25.1	110	100	70	90	170	290	110	110			70	90	90	90	100	110	720	780	1500
16244	9-3	129	33	90	100	80	90	230	200	120	100	60	40	110	90	100	110	110	120	900	850	1750
16282	9-4	133.4	31.3	110	100	60	90	210	210	180	170			100	90	100	90	110	100	870	850	1720
16247	9-5	132	30	120	120	80	70	220	220	180	150	40	50	90	80	100	100	100	90	930	880	1810
16246	9-5	140	38.8	130	120	90	110	190	240	190	170			150	140	160	130	150	200	1060	1110	2170
16286	9-5	138.5	29.9	110	100	80	90	240	220	130	120			110	110	100	100	110	110	880	850	1730
16281	9-6	124.5	26	70	90	50	60	170	200	130	110			80	100	110	100	90	80	700	740	1440

Continued on next page

TABLE XXXIX, Continued

16279	9-6	138.2	28.1	110	100	100	80	230	250	150	170			110	110	100	110	90	90	890	910	1800
16292	9-9	133	25	90	80	60	60	190	200	110	110			80	90	70	70	60	60	660	670	1330
16231	9-10	134	25	80	90	50	80	160	180	140	160			90	80	90	80	80	100	690	770	1460
16249	10-2	127	24.1	100	110	80	70	210	190	190	190			110	110	100	110	90	120	880	900	1780
16205	10-8	145.5	31.7	150	110	80	80	210	250	180	180			140	130	130	130	150	190	1040	1070	2110
16240	10-8	131	25.4	80	100	70	60	210	210	140	130			90	90	80	70	90	110	760	770	1530
16245	10-9	146	41.8	170	190	80	60	240	190	180	210	70	60	120	120	160	130	150	120	1170	1080	2250
16248	11-1	138	31.8	150	160	100	120	200	210	130	170	50	80	110	140	120	140	140	160	1000	1180	2180
16243	11-1	148	33	140	150	80	110	210	240	180	150	60	50	100	100	130	120	150	170	1050	1090	2140
15302	11-1	145.6	39.5	120	160	90	90	240	260	190	200			140	130	190	160	150	180	1120	1180	2300
16218	11-2	140.5	34.9	120	130	90	110	200	200	180	180			100	130	110	110	120	150	920	1010	1930
16232	11-3	144.5	36	110	90	90	80	190	230	160	160			100	110	110	100	150	120	910	890	1800
16207	11-3	138	29.6	90	100	70	90	260	220	190	140	50	50	110	100	120	90	100	120	990	910	1900
16219	11-4	146.4	51.5	180	150	130	120	210	240	190	150	90	80	140	130	130	110	190	230	1260	1210	2470
16210	11-5	143.6	36.5	130	150	90	80	260	280	240	190			150	140	90	120	210	210	1170	1170	2340
16209	11-11	148.8	36.7	130	110	120	100	240	240	130	120	60	40	110	130	110	110	140	140	1040	990	2030
16241	12-1	150	35.1	140	130	90	80	260	260	200	170	80	100	120	160	150	160	190	190	1230	1250	2480
3832	12-1	148.8	33.6	160	140	90	90	240	210	180	160	60	90	100	90	100	110	130	180	1060	1070	2130
16238	12-3	144.4	36.7	100	110	90	90	250	220	180	190			120	110	130	120	130	140	1000	980	1980
16242	12-5	145	35.5	130	110	50	80	210	230	150	190	60	60	90	80	100	90	120	130	910	970	1880
16211	12-5	148.5	41.1	190	170	120	110	280	240	210	220	90	80	120	130	170	150	190	200	1370	1300	2670
16288	12-9	145	35.5	70	60	70	70	140	140	110	120			90	100	90	100	60	70	630	660	1290
																				29240	29660	58900
																		Average		943	957	1900

		Probable Error
Height-Area of Carpal Bones of the right wrist coefficient	+ .729	±.0526
Weight-Area of Carpal Bones of the right wrist coefficient	+ .766	±.0464
Coefficient of Variation of Carpal Bones of the right wrist	12.698	

group. An exception is the fact that a child who ranked third for general physical development ranked fourth in 1919 for wrist area. The 1920 photograph, however, gave this individual third place.

b. *Data for Comparative Study 1920.* Making a comparative study of 31 girls and 36 boys of the Elementary School, and distributing the age, height, weight and exposed surface area of the eight carpal bones of the right arm and left arm, it will be noted in Table XXXVIII that on the average the total area of the bones of the right wrist is approximately the same as the area of those of the left, although there are great individual differences. It will also be noted that the relative area of the bones of the wrist of the girls is greater than that of the boys for the same chronological age. Girls are advanced not only in the development of surface area, but also in the formation of the pisiform bone, which is present in the case of 12 girls but only two boys. For the fourth girl, who is only nine years, three months of age, this bone is present. The youngest boy in which it has been noted is 10 years, four months, and the second boy 12 years, nine months, chronologically.

The coefficient of correlation between height and area of carpal bones of the right wrist is $+.729$, with a probable error of $\pm.0526$ for girls by the Pearsonian formula. For weight and area of carpal bones of the right wrist, the coefficient is $+.766$, with a probable error of $\pm.064$. The coefficient of variation of the carpal bones of the right wrist for the Pearsonian formula is 12.698.

For the boys the coefficient of correlation between height and area of carpal bones of the right wrist is $+.879$, with a probable error of $\pm.0275$; for weight and area of carpal bones of the right wrist, the coefficient is $+.755$, with a probable error of $\pm.052$. The coefficient of variation of the carpal bones of the right wrist for the boys, by the Pearsonian formula, is 29.94.

These results show a high positive correlation between height and the development of carpal bones, as indicated by the exposed surface area. The correlation with weight is also high. For height of boys the correlation is higher than for height of girls, and for weight, the coefficient for boys and girls is approximately the same.

These results also show that the coefficient of variability for boys is a little more than twice that for girls, which is in accord with the previous indications that boys vary more from eight to 13 years of age than do girls.

The previous photographs and the tabulated areas of these and the additional cases where the photographs have not been included, show that there are direct stages of growth of the carpal bones which may be expanded into an anatomical calendar for an individual boy or girl. At the present time the writer is formulating such an anatomical scale, using as a beginning of the standardization the photographs of the 280 children in the University schools.

c. *Conclusions*

I. The size and number of the carpal bones increase with age during childhood.

II. The development of the two wrists varies with individuals, but on the average there is no difference.

III. Girls at a given chronological age have a larger exposed surface area of the carpal bones of the wrist than have boys.

IV. Another evidence of the accelerated anatomical development of girls over boys is shown in the presence and development of the pisiform bone, which appears earlier during the pre-adolescent age with girls than with boys.

V. There is a high coefficient of correlation between height and area of the carpal bones (Boys +.879, Girls +.729) and also between weight and area of the carpal bones (Boys +.755, Girls +.766).

VI. Boys have a higher correlation than girls for height and area of carpal bones and about the same as girls for weight and area of the carpal bones.

VII. The coefficient of variation of the carpal bones is higher for boys than for girls (Boys 29.94, Girls 12.695).

3. The Anatomical Development of Disparate Twins

It has been stated universally, as far as the writer can determine, that the anatomical development of the carpal bones of twins of the same sex is the same at a given chronological age. For four years the writer has observed and measured his twin boys, Alan and Jervas. From birth, although much undernourished at the time, the one, Jervas, has not only been taller and heavier, but has constantly shown evidences of being more advanced physically and more mature mentally, though not so quick or bright in his mental reactions as the other, Alan. They are not identical twins and therefore

differ in appearance, temperament, disposition, motor reactions and intelligence ratings.

A. DATA ON PHYSICAL STATUS AND ANATOMICAL AGES OF TWINS

(1) *Alan and Jervas.* The accompanying reproduction of the physical examination measurement card gives the physical status

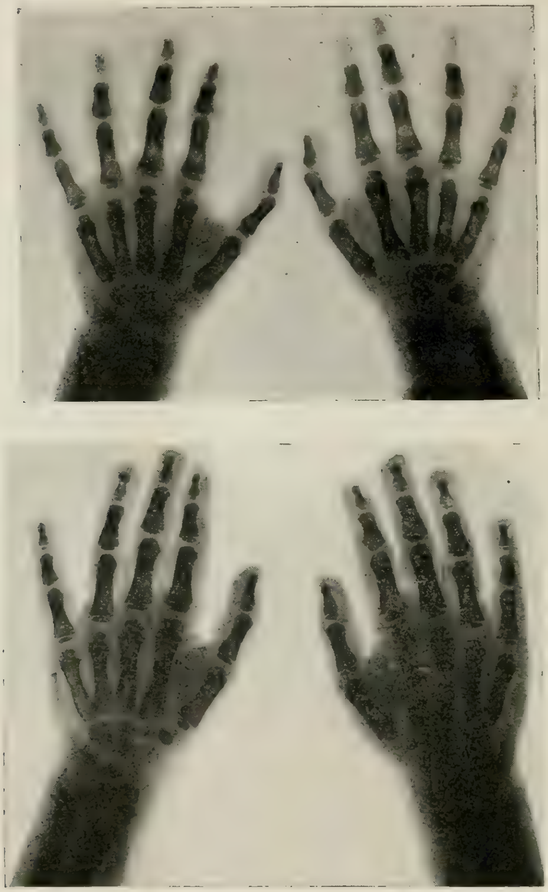
Name	Jervas	Alan	Robert	Richard	Sarah	Samuel
Place of examination	Iowa City	Iowa City	Iowa City	Iowa City	Iowa City	Iowa City
Date of examination	3-9-20	3-9-20	7-19-20	7-19-20	7-20-20	7-20-20
School year or grade						
Age	3-10	3-10	4-6½	4-6½	10-8	10-8
HEIGHT: Standing	103.2	99.1	104.5	104.5	143.5	144.0
Sitting	61.2	57.5	58.7	57.5	76.9	74.5
LENGTH: Span of arms	102.0	92.5	100.5	105.0	140.5	144.2
Shoulder—elbow	L 20.8 R 20.9	L 19.5 R 19.6	L 20.5 R 21.0	L 22.4 R 22.4	L 29.6 R 29.5	L 29.7 R 29.8
Elbow—finger tip	L 27.5 R 27.5	L 25.6 R 25.8	L 27.5 R 27.0	L 27.9 R 27.7	L 38.4 R 38.5	L 39.3 R 39.2
Knee—table	L 29.8 R 29.9	L 28.7 R 28.5	L 31.1 R 31.1	L 30.8 R 30.8	L 44.7 R 44.9	L 45.5 R 45.5
Face (chin-glabella)	15.2	14.7				
WIDTH: Shoulder	25.5	25.0	24.0	24.7	32.4	31.5
Hips	19.0	18.5	18.3	18.2	25.5	25.3
Face	12.0	11.4				
DIAMETER: Head (Anterior-posterior)	17.6	16.8	16.8	17.0	18.2	19.4
Head (transverse)	15.1	14.5	13.5	14.0	13.4	15.0
Head (height)	13.9	13.4	12.2	12.1	12.2	13.7
Chest: width	18.3	16.6	17.8	18.2	20.1	21.9
Chest: depth	13.5	13.3	13.4	14.2	15.9	15.8
CIRCUMFERENCE: Head	52.0	51.0	49.0	50.0	51.5	55.5
Chest	54.5	53.5	53.0	55.5	61.8	63.8
WEIGHT:	17.1	15.4	17.7	17.2	35.4	34.7
INDICES: Sitting—standing	59.3	58.0	56.2	55.0	53.6	51.7
Cephalic—index	85.8	86.3	80.4	82.4	73.6	77.3
Chest—index	73.8	80.1	75.3	78.0	79.1	72.1
Weight—height	.166	.155	.169	.165	.247	.241
Measured by	B.T.B.	B.T.B.	B.T.B.	B.T.B.	B.T.B.	B.T.B.

Chart LIV

of the two at the age of three years, ten months. It will be noted that Jervas exceeds Alan in all measurements, this relationship having existed, approximately, from birth. Both are now well developed, being close to a standard norm in their measurements and weight-height indices.

The larger boy, Jervas, was apparently further along in his anatomical and physiological development at birth, due, it may be, to a superior number of cells, even at this early age. Whether this is due to certain dietary factors or to the differences in the efficiency of the two organisms in utilizing the diet, or perhaps to their pre-natal positions, the writer does not know. He maintains that the one twin is anatomically and physiologically in advance of the other, presenting as further evidence, two roentgenograms at the chronological age of four years and two months.

These X-ray photographs (No. 15,154 and No. 15,155) made originally natural size, show striking and significant differences It may be seen at once that for Jervas (17) the ossification of the



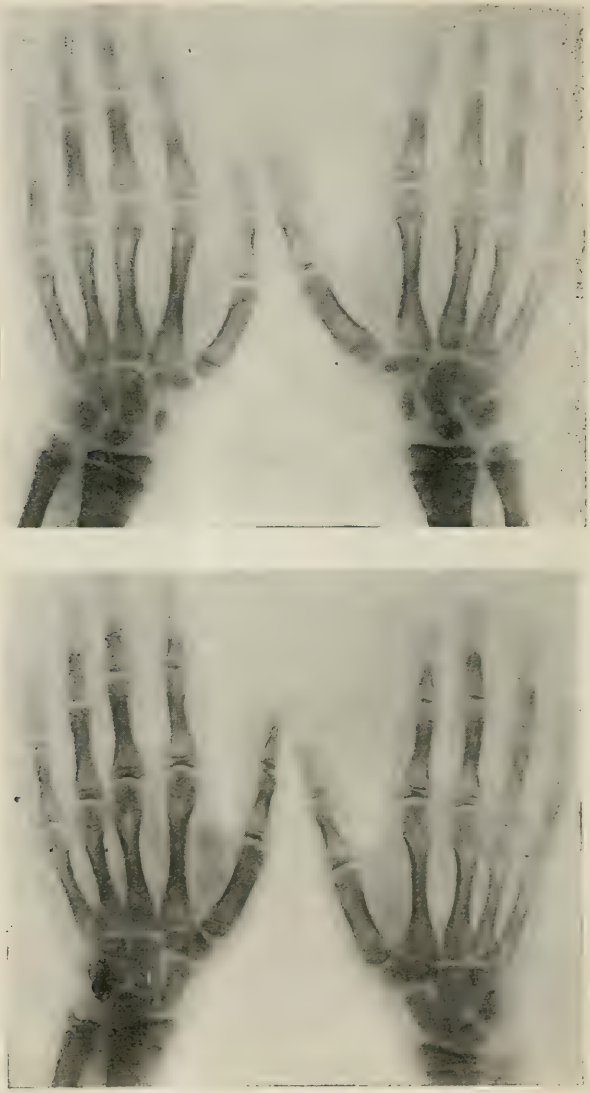
Photographs 16 and 17. Alvan and Jervas, Aged Four Years, Two Months

seven carpal bones is apparent, while for Alan there is no apparent center of ossification for the last three: trapezium, trapezoid and scaphoid, unless in the hand to the right the trapezium is making its appearance. It will also be noted that for Jervas the lower epiphysis of the radius is slightly more developed than for Alan, (16) with the diaphysis line a little clearer for Jervas. A significant difference in degree of development of the two boys may be noted in the presence of all of the epiphyses of all of the phalanges for Jervas and of the proximal ends for the first row for Alan, with beginnings for the second and third rows, particularly on the right

Photographs 16 and 17. Alan and Jervas, Aged Four Years,

hand. The lower epiphyses of the ulna are not present for either twin. The total area in square millimeters for the exposed area of Jervas' carpal bones is 760.8, and for Alan, 303.3.

The former, Jervas, has, according to the writer's judgment, reached an anatomical age of 5½ years, while Alan has attained approximately four years of age anatomically. On the basis of the accelerated development of carpal bones and on account of his



Photographs 20 and 21. Samuel and Sarah, Aged 10 Years

superior stage in maturation, Jervas has been sent to the University Elementary School this year (October, 1920), where he is with older children and is progressing satisfactorily.

(2) *Robert and Richard.* For comparison the physical measurements and roentgenograms (Photographs (18 and 19) No. 15,285 a

Photographs 22 and 23. Celia and Lorne, Aged 18 Years

TABLE XL

COMPARATIVE SURFACE AREAS OF THE CARPAL BONES OF TWINS IN SQUARE MILLIMETERS

BOYS AND GIRLS

			Trapezium		Trapezoid		Os Magnum		Unciform		Pisiform		Cuneiform		Semilunar		Scaphoid	
			1		2		3		4		5		6		7		8	
	Names	Totals	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
15154	Alan	303.3					71.0	90.3	58.0	6.5			32.3	25.8	6.5	12.9		
15155	Jervas	760.8	12.9	25.8	32.3	19.4	135.5	122.6	83.9	90.3			38.7	58.1	71.0	38.7	25.8	5.8
15285a	Robert	335.6					71.0	71.0	64.5	71.0			25.8	32.3				
15285b	Richard	522.8		6.5			122.6	129.0	83.9	71.0			32.3	32.3	19.4	25.8		
15303	Samuel	1451.7	38.7	71.0	64.5	19.4	225.8	225.8	141.9	141.9			122.6	96.8	90.3	83.9	71.0	58.1
15302	Sarah	2335.6	96.8	116.1	83.9	71.0	296.8	251.6	200.0	206.5			135.5	141.9	167.7	180.6	193.6	193.6
15277	Celia	3019.2	148.4	161.3	129.0	148.4	341.9	316.1	225.8	238.7	103.2	116.1	141.9	135.5	167.7	200.0	258.1	187.1
15278	Lorne	3174.1	167.7	148.4	141.9	135.5	341.9	341.9	271.0	238.7	129.0	96.8	148.4	122.6	212.9	167.7	271.0	238.7

and No. 15,285 b), of two other twin boys, Robert (18) and Richard (19), eight months older but relatively smaller than the two previous boys (Alan and Jervas) are given. These two boys are the same in height and almost the same in weight and in appearance. In area of the carpal bones they are very close to each other, Robert having 335.6 square millimeters and Richard 522.8 square millimeters. These are supposed by many to be identical twins.

(3) *Samuel and Sarah.* For further comparison and as a definite illustration of the differences in anatomical age due to sex, the physical measurements (17) of two 10 year old twins—a boy and a girl—Samuel and Sarah (Photographs (21) No. 15,302; (20) No. 15,303) are given. Sarah is within five millimeters of being as tall as Samuel and is .7 of a kilogram heavier. For a girl she is further above the standard for her age than Samuel is for the boys' standard. For the next three years she should exceed Samuel in all measurements except those of the head.

The same anatomical acceleration is evident in the development of the carpal bones. All are present for both children except the pisiform. Samuel has a total exposed area of 1451.7 square millimeters, and Sarah an area of 2335.6 square millimeters, she being anatomically about two years in advance of her twin brother.

(4) *Celia and Lorne.* The two sisters whose radiograms (Photographs (22), No. 15,277 and (23) No. 15,278) follow are 18 years of age and they too are considered identical twins. In anatomical development of the carpal bones, Lorne (23) is in advance of her twin sister, having a total area of 3174.1 square millimeters, and Celia (22) 3019.2 square millimeters. Both girls have the pisiform present, which, as previously stated, does not appear until after entrance into adolescence.

B. CONCLUSIONS

Using the development of carpal bones as criteria of anatomical development, it has been discovered that:

I. Disparate twins of the same sex may differ to a marked degree both in the number and in the exposed area of the carpal bones at four, four and a half, and 18 years of age.

II. In the case of twins of different sex, the girl is accelerated to a marked degree over the boy at the age of 10 years.

CHAPTER VIII

PHYSIOLOGICAL AGE

1. The Age Distribution of Pubescence of Boys and Physiological Maturation of Girls

The subjects of physiological and anatomical ages have been confused in the literature, because neither has been investigated empirically beyond a limited degree, although both are full of fertile problems of great significance in the study of individual development. The direct applications of the meaning of these ages to physical, mental, pedagogical, social and moral development have been recognized to a very limited extent.

There is a wide range to be found in the physiological differences between boys and girls of the same chronological age, as will be demonstrated by the data following. Some boys reach pubescence at 11 years of age, others not until 16 years of age; some girls reach this period of maturity at 10 years of age or earlier, others not until 16 or 17. Boys and girls who mature early in these functions may be considered physically older than those of later maturation.

a. *Data for Boys.* In order to determine the wide range of chronological ages that characterize the stages of physiological growth which are entered into at adolescence, the writer and one of his advanced students at Johns Hopkins University, Charles F. Pennington, checked very carefully some material that was gathered under the direction of Dr. William Burdick and Dr. Brown on the ages of pre-pubescence, pubescence, and post-pubescence in boys. (28) In Baltimore 3600 boys of a "motor" type of development, that is, those taking part in athletics, were examined. These data were supplemented by those from a group of 1317 boys from 14 counties of Maryland, making a total of 4917 boys. With these particular children the criterion was that of pubescent growth and pigmentation of fine hair, which characterizes a very brief period of time marking the change from asexual to sexual life, when the ability to procreate is established.

It is found that the *pre-pubescent* boys range from eight and one-half to 16 years of age in the group of country boys, and from

nine and one-half to 17½ for the city boys. The *post-pubescent* ages range from 11½ to 24 for the country boys and 12½ to 24 for the city boys. For the *pubescent* stages the country boys range from nine and one-half to 15½, with the mode at 13½, and the city boys from 10 to 18, with the mode at 14. The country boys reach this period earlier than the city boys. At no age are more than 53 percent of the age group of the city boys pubescent or more than 40 percent of the country boys.

A method is now being formulated and carried out by the writer with the University of Iowa Junior High School boys, which indicates that pubescence is but a rough and inadequate criterion of the secretion of the sperm cell.

b. *Data for Girls.* For the girls the criteria were the first menstrual flow, enlargement of the breasts, the appearance of sub-

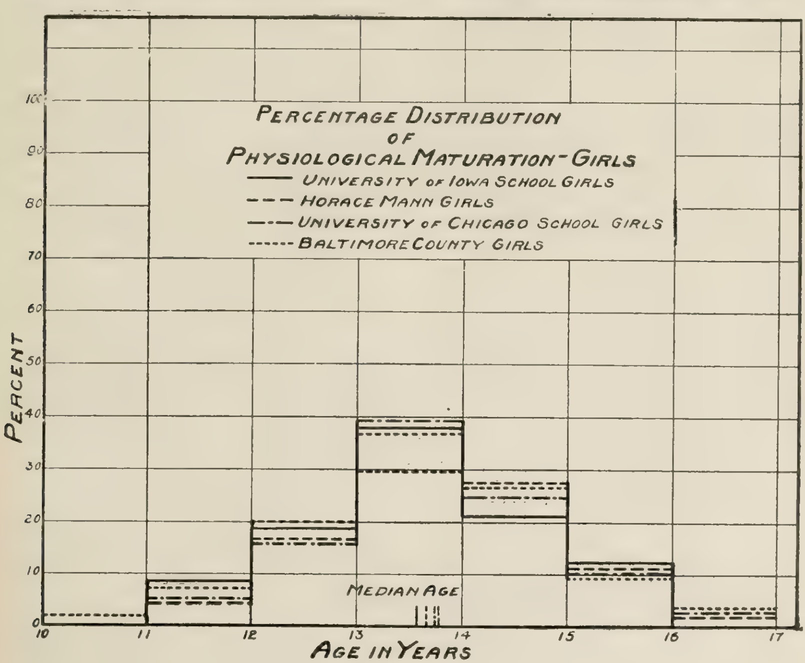


Chart LV

cutaneous fat, and axillary hair, as noted by the physician or nurse. Chart LV shows the age distribution in terms of percent of 47 girls from the University of Iowa Elementary and High School who had their first period of menstruation between the ages of 10 and 17

years; and a similar distribution for 151 Horace Mann school girls, 56 University of Chicago Elementary and High School girls and 134 Baltimore County girls from the Baltimore Athletic League. These data are accurate and represent typical groups of normal girls from the middle and upper class homes.

These data furnish satisfactory criteria for specific purposes, but

TABLE XLI

PERCENTAGE DISTRIBUTION OF PHYSIOLOGICAL MATURATION—GIRLS

1. University of Iowa Elementary and High School Girls			
Ages	Cases	Percent	Median
11	4	8.51	13 years,
12	9	19.14	7 months
13	18	38.29	
14	10	21.27	
15	6	12.76	
	47	99.97	
2. Horace Mann Elementary and High School Girls			
Ages	Cases	Percent	Median
11	7	4.63	13 years,
12	25	16.55	9 months
13	56	37.08	
14	42	27.81	
15	17	11.25	
16	4	2.64	
	151	99.96	
3. University of Chicago Elementary and High School Girls			
Ages	Cases	Percent	Median
11	3	5.35	13 years,
12	9	16.06	9 months
13	22	39.28	
14	14	25.00	
15	6	10.71	
16	2	3.57	
	56	99.97	
4. Baltimore County Girls, Maryland			
Ages	Cases	Percent	Median
10	3	2.23	13 years,
11	10	7.46	8 months
12	27	20.14	
13	40	29.84	
14	36	26.85	
15	13	9.70	
16	5	3.72	
	134	99.94	

other types of criteria are being worked out at the present time by the writer.

c. *Conclusions*

I. These data show that among children who are best developed from a physical point of view, there is no fixed age for physiological development as evidenced by the advent of pubescence or first menstruation. Adolescence does not begin at the same chronological age for all normal boys or for all normal girls, physiologically speaking. Children, boys or girls, may be of the same chronological age between 10½ and 16½ and differ in physiological age from one to four or five years and still be normal in physical development. The norm for pubescence is a distribution range, not an average chronological age.

II. At no age do as many as 40 percent of the groups mature.

III. There is a range in ages from 10 to 17 years for the age of first menstruation for normal girls.

IV. The girls from the country and from the smaller city (11,000 population) mature earlier than those from Chicago and New York, the median ages being respectively 13 years eight months, 13 years seven months, 13 years nine months and 13 years nine months. This conclusion substantiates the similar condition found for boys (28 p. 15).

2. Relation of Establishment of Maturity to Height of Girls

a. *Data.* In order to find the correlation from another angle between physical growth and the date of maturity (first menstruation) of girls, 151 Horace Mann girls and 53 University of Chicago high school girls between 11 and 17 years of age were taken, with the heights recorded at the time of the appearance of this physiological function.

It was found for the Horace Mann School, Columbia, that the seven girls who matured at 11 years of age had an average height of 148.2 cm., with the average or norm for the school at 140.39 cm.; the 25 girls who matured at 12 years of age had an average height of 152.1 cm., with the average or norm for the school at 146.22 cm.; the 56 girls maturing at 13 years of age had an average height of 155.3 cm. and the norm was 152.74 cm.; the 42 girls maturing at 14 years of age had an average height of 159.6 cm. and the norm was 156.97 cm.; the 17 girls maturing at 15 years of age were 158.5 cm.

in height and the norm was 159.35 cm.; and the four girls maturing at 16 or a comparatively late age were 163.2 cm., while the average for the group was 161.59 cm.

It was found that in working with the data for the 53 girls from the University of Chicago, those who matured at 11 years of age had an average height of 146.9 cm., while the average or norm was 141. The nine who matured at 12 years of age had an average height of 151.4 cm., with the average or norm for the school of 146 cm. The 22 girls who matured at 14 years of age had an average height of 154.7 and the norm was 153 cm. The 14 girls maturing at 14 years of age had an average height of 158.7 cm. and the norm was 157 cm. The six girls who matured at 15 years of age were 159.6 cm. in height and the norm was 159 cm.; and the two girls maturing at 16 or a comparatively late age were 161 cm., with the average for the group 160 cm.

b. *Conclusions*

I. These results show that girls who mature early are on the average close to the norm or below it. This is contrary to the current belief that early maturation is a sign of poor health.

3. Individual Growth Curves

a. *Data.* As soon as the wide range of pubescent development in terms of chronological ages is appreciated, the question arises, what underlying principle governs this period of physiological ripening and causes such differences in the phases of physical maturation. This may be made very clear by the following charts taken from a previous investigation (28), where the individual growth curves are given and the establishment of the period of first menstruation is indicated by heavy black dots. It must be recognized that a limited number of type cases are given, but they are all approximately normal. Since these are individual pictures, their validity is established and their worth of permanent value for future analyses. An application of scientific procedure will find several other conditions, such as heredity, social environment, climate, exercise and nationality as important determining factors. The problem here, as in the other sections of this *Study,* consists in finding the basic facts for further study of the normal child.

In the collected results in Chart LVI it may be noted that tall girls as a rule mature earlier than short ones. This was shown in the

writer's original study (27) by means of individual growth curves.

The individual growth curves in height shown in Chart LVI give some exceptions to this rule, but they demonstrate the law that early maturity means that growth is nearing completion in height

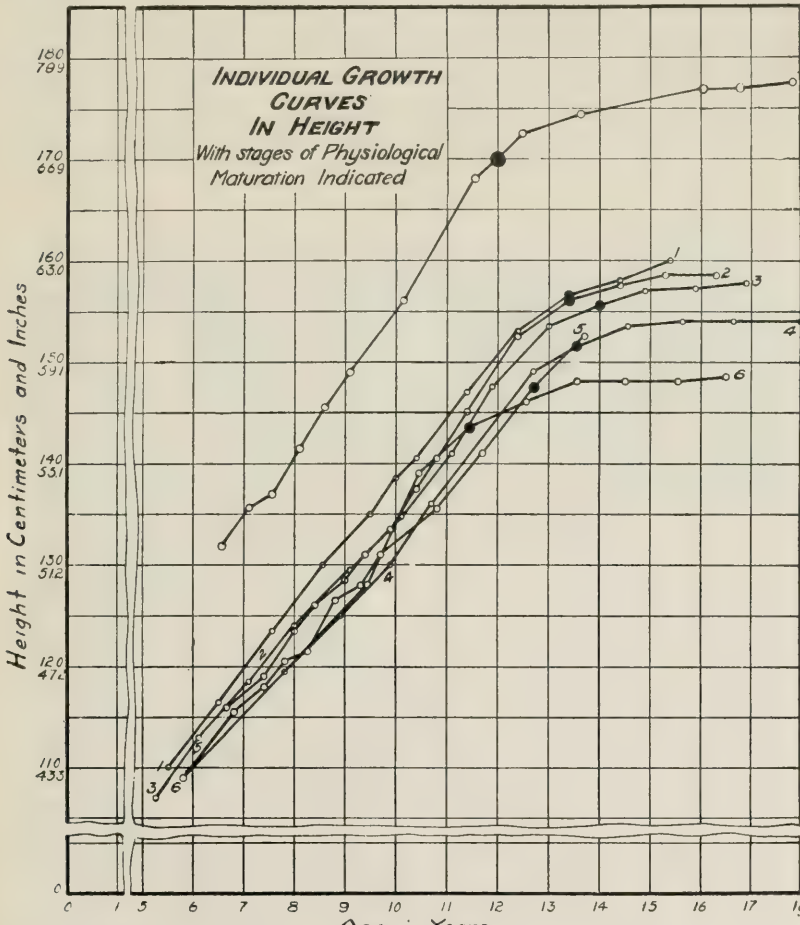


Chart LVI

as well as sex development. Individuals 4, 5 and 6 should normally mature late, but they matured relatively early and soon after this period there was a diminution in growth. This is very striking in the case of No. 6. Nos. 1, 2, and 3 matured approximately at normal age for their height, since none are tall

girls. The tall girls, 1a and 1b, show a striking contrast. The six girls are not only relatively small, but all have had serious illnesses. No. 1 had scarlet fever just before 13 years of age. No. 2 was anaemic throughout her school life, with lumbar curvature, intestinal disturbances and rapid and irregular heart. No. 3, a sister of No. 1, had scarlet fever at the same time, with poor posture during high school period. No. 4, in addition to having had many children's diseases, was very nervous. No. 5 had poor posture, and also had hernia and enlarged tonsils. No. 6 had enlarged glands of the neck and hip disease from a fall. No. 1a and 1b were healthy Chicago girls.

b. *Conclusions*

I. Tall girls of a fairly homogeneous group, as a general rule mature earlier than short ones.

4. Relation of Maturation to Growth

a. *Data.* The relation between the cessation of growth and the advent of sex maturity may be shown by a study of the average annual increments of growth between nine and 18 years of age. For the girls who matured at 11 years the increment of growth increased rapidly from nine to 11 and dropped rapidly almost to the one centimeter point at 14. For those girls who matured at 12

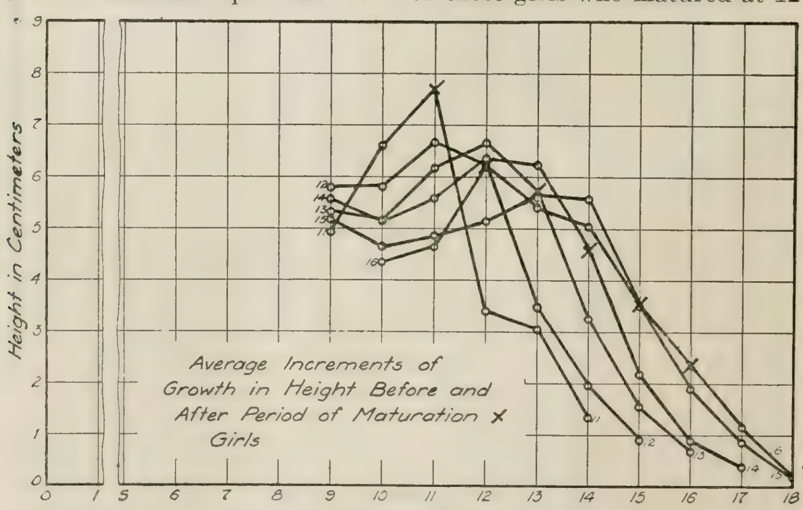


Chart LVII

years of age, there was an increase in the average increment until 11, then a slight drop and after 12 a rapid cessation until 15, when it was below the one centimeter increment. For those who matured at 13 there was a slight drop at 10 and an increase until 12, then a drop to less than one centimeter at 16. For those who matured at 14 there was a slight drop until 17, at which age the average is less than one centimeter. For the 15 year old girls there was a relatively high increment until 14 years, when there was a rapid decrease to less than one centimeter at 17. For 16 year old girls the rapid drop also began at 14 years and reached the minimum at 18 years of age.*

* Data from Horace Mann, University of Chicago and F. W. Parker Schools.

Photograph 24. Four children of the same chronological age (11 years), with different physiological ages. Katherine, Dorothea, Siegfried and Wilbur

b. *Conclusions*

I. Early maturity is followed, as a rule, by a rapid cessation of growth in stature. For girls who mature at 11, a rapid decrease in annual increment follows until 14, where there is less than a centimeter of growth. For those who mature at 12 a rapid decrease in increment follows until 15, when there is less than a centimeter of growth.

II. For girls who mature at 13 or later, the decrease in increment begins in the year previous to maturation, and reaches one centimeter or less three years later.

III. The decrease in yearly increment is more prolonged for girls who mature late.

IV. There is a positive correlation between physiological stages of maturation and anatomical age, as evidenced by height, weight, and the development of the area of the carpal bones.

5. Applications of the Concept of Physiological Age

Six distinct applications of the concept of physiological age in child development may be cited here:

a. *To Physical Training.* Physiological age has a direct bearing on physical training and directed play. Not only do children naturally play with boys and girls of their same physiological age, but the types of games in which they participate are dependent upon the stage of physiological maturity. It would be justifiable to arrange physical training schedules in schools on the basis of physiological age, giving boys or girls of the same physiological age similar types of exercise. On the average, girls are older physiologically than boys.

b. *To Stages of Mental Maturation.* Physiological age is, the writer believes, directly correlated with stages of mental maturation. The physiologically more mature child has different attitudes, different types of emotions, different interests, than the child who is physically younger though of the same chronological age. While a child may be precocious intellectually, and have a high intelligence quotient and pass beyond its chronological age in the development of certain mental traits, other types of traits indicative of mental maturity may be undeveloped.

Another experimental study just completed shows that the mental age of the individual bears a direct relationship to the physiological age as indicated by height and weight. The results show

that at each chronological age the physiologically accelerated boys and girls have a higher mental age than those of the average or below the average physiological age. The girls, when classified on this basis, show a higher mental age for a given chronological age than do the boys. Girls are on the average mentally older than boys.

c. *To School Progress and Promotion.* Physiological age has a direct bearing on pedagogical age, as many of our schools are beginning to recognize. The larger and physiologically more mature child may be able to do certain types of school work better, although of inferior ability in specific traits which have been greatly emphasized by school curricula. No child should be promoted or demoted without taking into consideration his or her physiological age. Girls may be expected to progress more rapidly than boys.

d. *To Industrial Work.* There should be a direct relationship between physiological age and the age at which boys and girls enter industrial work. Child labor legislation should take into consideration the physiological development of the boy or girl as well as his or her chronological age and school standing. Some children are sufficiently mature physically to meet the requirements of an age limit of 14 or 16, while others are immature and in a stage of physiological growth where more school training, more physical training and more opportunity for physical development are essential.

e. *To Social Adjustment.* That there is a direct relationship between social age and physiological maturity needs only to be mentioned to be evident. Some girls at a given chronological age are sufficiently mature to meet the social conditions which may arise, while others are not. It is apparent that in dealing with children, especially delinquents, between 10 and 18 years of age, there is a tremendous problem involved which rests directly on the physiological age of the individual. Girls face this problem earlier on the average than do boys. In a particular case it may mean a social misfit for life with another child involved, or the individual may be subject to remedial social training and development.

f. *To Moral and Religious Awakenings.* The commonly observed periods of moral and religious awakening in children, particularly at 12 to 16 years of age, show that there is a close relationship between physiological age and religious development, with girls preceding boys.

PART IV

CHAPTER IX

HISTORICAL ORIENTATION

1. Introduction

a. *General Summaries of Literature on Growth.* During the past two centuries there have been many valuable scientific investigations in physical growth, but only a few sustained efforts have been made to make a comprehensive survey of the field, aside from reviews from particular angles. A portion of the literature on growth is summarized in Roberts' (663) *Manual of Anthropometry,* 1878; Sack's (681) dissertation, 1892; Topinard's (822) *Anthropology,* 1895; Burk's (136) *Growth of Children in Height and Weight,* 1898; Macdonald's (490) *Experimental Study of Children,* 1897; Daffner's (193) *Das Wachstum des Menschen,* 1902; Ernst and Meumann's (241) *Das Schulkind in seiner körperlichen und geisten Entwicklung,* 1906; Vierordt's (846) *Anatomische und physikalische Daten und Tabellen,* 1906; Weissenberg's (865) *Das Wachstum des Menschen,* 1911; Baldwin's (27) *Physical Growth and School Progress,* 1914; Martin's (505) *Anthropology,* 1914; and Hrdlička's (405) *Physical Anthropology,* 1919.

b. *International Scope of Contributions.* The present status of the scientific literature on physical growth shows many countries contributing, among which are America, England, Scotland, Ireland, Canada, Australia, France, Norway, Denmark, Sweden, Spain, Holland, Belgium, Switzerland, Italy, Germany, Austria, Russia, Poland, Finland, China, Japan, and the Philippine Islands.

The largest amount of scientific material and probably the best, has been gathered or formulated in the United States, England, Germany, France, Russia and the Scandinavian countries, with little from South America and from China directly. Repeated attempts have been made to secure available material through correspondence and conferences. In England the investigations have usually included large numbers of individuals, principalls adults, and have been undertaken for practical ethnological, sociological,

military and hygienic purposes. In Germany, where more detailed analytical work has been done with children and adults, the point of view is that of the physiological development of the individual. In Russia the physiological and pedagogical points of view have also predominated; in Italy the criminal and pedagogical; in China and Japan the pedagogical; while in Norway, Sweden and the Netherlands the anthropological and pedagogical motivations have been the determining factor. In America, where large numbers of children have been measured and compared in different parts of the country, the work has been done primarily by physicians, anthropologists, anthropometrists, psychologists and educators.

2. Early History of Growth Studies

a. *General Fields Included.* In making an historical survey of the scope, methods and purposes of investigations of physical growth, it may be noted that the scope includes the study of infants, both prenatal and postnatal, children, adults, and occasional comparisons between animals and human beings. The group method has predominated, where different groups of individuals have been measured for different ages and the averages obtained have been supposed to represent consecutive growth periods in the same individual. The literature shows very few studies on a considerable number of cases by the individualizing method. The earliest of these was published by Vahl (832), 1884, followed by that of Landsberger (456), 1888, who measured 37 children for a period of seven years. Then followed Wiener (879), 1890, who measured his four sons consecutively from birth through childhood. In 1910 King (437) presented measurements of his two boys, in one case for six years and in the other for three years. There have been other studies of individual children by Mrs. W. S. Hall, (342), by Major, by Karnitzky (422), Wissler (883), Moon (534 and 535), Boas and Wissler (100), and by Camerer (144-148). Godin (299), 1910, presented the results of four annual measurements on 100 boys. Matthias (507), 1916, investigated the effect of physical exercise on 737 Swiss athletes, each measured three times a year from the age of 16 to 22. Porter (618) in 1920 had obtained weight data on a large number of Boston public school children who had been weighed from 1909 to 1919. The investigations of Baldwin (27 and this *Study*) follow the individual growth curves for a number of physical traits on

several hundred children from various sections of the United States for periods of 10 to 12 years.

b. *The Influence of Sculpture and Painting on the Study of Growth.* Scientific anthropometry arose mainly from the desire to find the best proportions for the beautiful forms that artists wished to represent. Although no specific references have been found in Greek and Roman literature to actual anthropometric work among these peoples it is evident that the sculptors must have measured the human body in order to make the exact copies of the victors in the athletic games whose statues were customarily placed in temples and public squares and served as examples or norms of perfect physical development. It is known that artists were in the habit of frequenting the gymnasia in order to study the physique of the youths and maidens who were exercising there. Phidias is said to have used twenty models in order that the most beautiful parts of each might be assembled into one figure.

The artistic tradition was carried on by Dürer's (226) folio published in Nüremberg, 1528, which contained much material on human proportions. In 1654 Elsholt (232) published at Padua his *Anthropometria*, the first modern work on anthropometry, in which were included pictures of the perfect body and illustrations of anthropometric instruments. Audran (21) published a study at Paris, 1683, which gave the diagrams and measurements of twenty-five famous statues. Bergmüller (55) 1728 wrote one of the early treatises on anthropometry. David (201) 1798, also published material about the famous statues of antiquity.

The historical association of the artistic movement with the interest in anthropometry generally is shown by the fact that in 1770 Sir Joshua Reynolds called attention in an address delivered before the Royal Academy of Fine Arts to the differences in the measurements of the human form from childhood to adult life. Camper's (157) 1803, works may serve as an example of the earlier modern anatomical treatises. It is to Quetelet, who coined the word anthropometry, that credit should be given for the first scientific study of physical growth. In 1830 were published the results of these first investigations in which the artistic procedure was joined to the new scientific method of empirical measurement and induction. The artistic tradition was continued in such work as that of Fock (256) 1850, who posited Apollo Belvedere as the model for human proportions, and of Story (786) 1866, who gave a detailed study of

parts of the body with many allusions to the work of classical scientists, while Schadow's (696) *Polyclet*, 1834, carried the study of human proportions a step further in that it took account of sex and age and gave actual life sizes.

3. Methods and Technique

A. LACK OF UNIFORMITY IN METHODS

Since these early studies a vast amount of work has been done in the field of experimental measurements and physical tests. Unfortunately there has been a great lack of uniformity in methods of measuring, standardization of instruments, units of measurement, parts to be measured, topographic points to be accepted, methods of recording data, methods of estimating ages, time of day for measuring, and intervals for repetition of measurement. The English authorities and many Americans have used the inch divided into tenths as a unit measure, although many investigators have used the eighth of an inch. In practically all other countries, the metric, or French system, has been used, with obvious advantages, since the system is the scientific standard used in most countries and in all other departments of science; it is a decimal system and is easily translated into the English system.

There has also been great confusion in the selection of the parts to be measured, since this should be dependent upon the purpose for which the measurements are being taken—that is, the value to the individual examined, the value to anthropology, the value for the science of physical measurements, the value for an educational program, or the value for correlations with psychological traits. What is needed at present is a standardization of all these factors and a definite statement of the purpose for which each investigation has been made.

B. THEORETICAL DISCUSSIONS AND GENERAL TREATISES ON GROWTH

Many contributions to the theory of anthropometry and numerous considerations of technical questions are to be found in extensive investigations which are listed in later sections of this historical orientation. The summaries of the literature on growth listed in Part VI also contain much material of this kind. The first important special contribution to theory was Galton's

(282) short account of an anthropometric laboratory and his (283 and 284) discussion of anthropometric percentiles, 1884 and 1885. Boas (83) in 1894 contributed to the theory of measurements and in 1904 published his discussion of variable quantities (92). In 1894 Pearson (575) wrote on Galton's percentile method. Boas and Wissler (100) 1904, issued their study on statistics of growth which was a continuation of Boas' (91) 1902 statistical study of anthrometry. Weissenberg's (860) anthropometric principles and methods appeared in 1904. As early as 1893 Titchener (821) made a noteworthy distinction between anthropometry and experimental psychology. The latest contribution to this field is Hrdlička's (406) articles on the anthropometry of the living, in 1919. The recent works of Schiötz (707), 1919, in Norway and of Őrum (569), 1919, in Denmark, make special contributions to statistical method.

Among the writers of general treatises bearing directly on growth, those that are most significant are Thoma (812 and 813), 1882, Frölich (275), 1896, Ellis (231), 1896, Donaldson (213), 1896, Chamberlain (165) 1900, Thorndike (817) 1901, Buschan (139) 1909, Griffith (321) 1909, Boas (96-98) 1912, Kirkpatrick (440) 1917.

C. MANUALS

A description of the methods of making physical measurements with tables of norms and an account of the general growth process has been published in manual form by Gulick (328), 1892, Megret (516) 1895, Hitchcock, Seeley and Phillips (390) 1900, Hastings (356) 1902, and by Seaver (743) 1909. Books on statistical methods which are applicable to anthropometric work are Davenport's (197) *Statistical Methods*, 1899, and Thorndike's (818) *Mental and Social Measurements.*

D. GROWTH FORMULAE

Probably the greatest development in anthropometric methods of recent years has consisted in the extended use of mathematical expressions for various growth phenomena. Beginning with Quetelet in 1836, investigators who have had at their disposal a collection of various measurements of the body on different individuals for an extended series of years, permitting them to calculate the yearly increments, have attempted to express their growth curve by means of a mathematical equation. Since this pioneer work, the

derivation of formulae has aided materially in the development of a science of human growth and also in coördinating and correlating the work of the various investigators, especially in reference to total and partial growth of the body. It should be noted that all of the formulae are only approximations, for growth varies in total and partial bodily proportions at different chronological ages, in different sexes, in different races, at different stages of physiological maturation, at different times of the year, and under various environmental and nutritional conditions.

(1) *Rate of Growth.* One class of these formulae has been designed *to express the normal rate of growth throughout life;* that is, to give the shape of the curve for relationships of particular measurements such as height or weight. Such formulae rest on the assumption that the normal individual has a certain growth capacity or growth energy at birth. Consequently the value of any measurement at any time of life can be obtained by solving an equation in which certain other values are known. For example, instead of comparing the actual weight of an infant with the norm for its age, the weight it should have at that age may be calculated by filling in the formula. Some writers have constructed tables of norms by making a few determinations and interpolating values that seem to conform to the growth curve as they find it. Accurate formulae, including relationships for more than a few years, have been impossible, particularly previous to this *Study*, since individual growth curves for childhood have not been available.

Quetelet (626-634) used both classes of formulae, concluding that the weight of the body in the various years of life is proportional to the fifth power of height. The formula is:

1. For weight. $g = G \sqrt{\frac{l^5}{L^5}}$

where

g = weight to be found; G = birth weight; l = height;
L = birth height.

The increase in weight has also been worked out theoretically by Finkelstein.

2. For height increase Quetelet used the formula:

$$y + \frac{y}{1000\,(T - y)} = a\,x + \frac{t + x}{1 + 4/3x} \quad \text{where}$$

x = age in years; y = height corresponding to this;
t = height of new-born; T = height of adult;
a = yearly increase between ages 4-16.

An elaborate but somewhat fantastic and inaccurate scheme was devised by Liharzik (474), 1858. The result seemed to indicate that all measurements show that growth takes place in epochs and that in each period of a single epoch the same increase takes place; *i. e.* if L is the height at birth, this increases in the first month by λ in the second and third months together by λ; in the fourth, fifth and sixth months by λ. The second epoch begins from the twenty-second to the twenty-eighth month, from the twenty-ninth to the thirty-sixth month, and so on, to 171 months, the increase in each case being still λ. The third epoch has a similar increase. Liharzik's division into epochs and periods with the corresponding months of life was:

I. Epoch 6-5/6 cm. increase												
Period	1	2	3	4	5	6						
Months	1	3	6	10	15	21						
II. Epoch 6 cm. increase												
Period	7	8	9	10	11	12	13	14	15	16	17	18
Months	28	36	45	55	66	78	91	105	120	136	153	171
III. Epoch 2 cm. increase.												
Period	19	20	21	22	23	24						
Months	190	210	231	253	276	300						

Liharzik did not work out his formula mathematically but Raudnitz (648), 1892, had Liharzik's measurements worked over by a mathematician who devised formulae.

Zeising (906), 1858, believed that growth in height took place in such a way that the parts of the body were related to each other in the ratio of the *golden section.* The formula is:

$$x : y :: y : (x + y).$$

Another early mathematical derivation of a growth formula, but without observational material, was made by Kaiser (420), 1875. Attempts have been made to give mathematical expression to the general bio-chemical law of growth. Robertson, (664) 1897, published a growth formula derived from the results of Quetelet and of the British Anthropometric Committee. It was found that any particular cycle of growth obeys the formula:

$$\log \frac{x}{A - x} = K (t - t_1)$$

where x = amount (in weight or volume) of growth which has been attained in time t; A = total amount of growth attained during the cycle; K is a constant; and t = time at which the growth due to the cycle is half completed. The author shows that the formula holds true for plants and their elements as well and thinks that growth is an autocatalyzed process in both inorganic and organic life.

The belief in the parabolic character of the growth curve has led

to a considerable amount of discussion. Wiener, 1890, (879) reported continuous measurements on his four sons. Inspection of these measurements led Wiener to the belief that between the ages two and 12 the growth curve is part of a parabola which can be analyzed to give the general formula:

$$y^2 = a(x + b).$$

According to this formula, the axis of the parabola is parallel to the abcissa and its vertex is located to the left of the middle of the system at a distance represented by *b*, the values of the constants *a* and *b* varying somewhat with different individuals. Hall (341) 1895, in a study of the principles of growth by rhythms concludes, "When the vertical dimensions of the human body are undergoing acceleration of their rate of growth, the horizontal dimensions undergo a retardation of their rate of growth, and conversely."

In 1903 von Lange (460) corroborated Wiener's findings in regard to the parabolic characteristics of the curve from two years to the beginning of puberty, but tried to draw an analogy between the laws governing growth and the general laws of motion.

Reinus (651) 1915, in a dissertation under Pfaundler's direction, made an attempt, with different sets of measurements drawn from the literature on growth in height, to find a parabola that would fit the observed facts. This attempt was unsuccessful. Pfaundler (590) 1916-17, working over the data of Friedenthal on the average growth curve of the typical male, found a formula which would express growth in height from birth to the end of puberty. This is:

$$x = n\,y^3$$

where x = the age in years dating from the time of conception; y = the height in meters; and n = a constant about 4.75 in value. This formula means that age is proportional to the third power of height. By mathematical procedure, Pfaundler also found that when height and density remain constant, weight during the growing period is also proportional to age.

Another type of formula has been developed by workers on the caloric requirements of infants, since the amount of milk to be given at each feeding is to be computed on the basis of the "theoretical weight" for any particular age. Daniels and Byfield (195) 1919, for example, find the theoretical weight by using the following adaptation of Finkelstein's rule: birth weight − (600 × age in months) − 300 = weight for first six months. Birth weight − (500 × age in months) = weight for second six months.

(2) *Relationships in Growth.* A second class of formulae *expresses the relationship between two physical traits.* The use of these formulae, or better, "indices" is based on the assumption that there is a constant relationship between the growth of the body in the two traits concerned, as for example, in height and in weight. A few investigators have constructed curves showing the value of these indices for each year of life and the curves have been used for diagnostic purposes.

Boulton (108) 1876, though offering no formula, stressed the constant relationship between weight and height and foreshadowed the modern point of view that weight alone is no criterion of normal development. It is the relation of the two expressing robustness that is important. Porter (617) 1896, also emphasized the importance of the height-weight ratio. Ranke (644) 1894-1900, used the following formulae:

$$\text{Weight-height index} = \frac{W}{H}; \qquad \text{Vital-height index} = \frac{V}{H}$$

$$\text{Leg-height index} = \frac{L}{H}; \qquad \text{Head-height index} = \frac{h}{H}$$

Enebuske (235) 1892-94 assembled or devised formulae for the following relations:

$$\text{Total strength-weight index} = \frac{TS}{W}; \quad \text{Power index} =$$

$$TS\,\frac{LC}{W}; \ \text{Vital strength-weight index} = \frac{LC}{W} \times \frac{TS}{W}$$

Oeder (555-557) 1909 and 1910 combined height and weight into an index. Weissenberg (865) 1911, compared thirteen measurements with height and used nine other indices expressing the relations of various parts of the body to each other.

Gaertner (278) 1912, developed a formula to express the relationship of height and weight, computing thereby a table for the normal weight of adult men and women (for each 1 centimeter increase in height).

Tuxford (826) 1917, has used a formula in which the variable factors are:

$$\text{For boys:} \quad \frac{\text{Weight in grams}}{\text{Height in cms.}} \times \frac{381 - \text{age in months}}{54}$$

$$\text{For girls:} \quad \frac{\text{Weight in grams}}{\text{Height in cms.}} \times \frac{384 - \text{age in months}}{48}$$

The results are empirical and fall within childhood ages. This writer states that the average for normal children should fall within 990 and 1010.

Matusiewicz (508) 1914, also wrote on the height-weight coefficient.

An index relating height and arm span was discussed by Knoop (444) 1918. Feri (252) 1893, developed a relationship between length of trunk and weight.

(3) *Total and Partial Growth in Volume.* A recent trend has been the development of formulae which should not represent merely linear relationship but should take into account the fact that the body is a three dimensional object. As early as 1879 Meeh (514) began a study of regions or parts of the body to be measured and of the body and total volume, and in 1895 (515) a relationship was shown between the volume of a single part of the body and total volume in infant and adult life.

Among formulae designed to introduce the factor of the third dimension is the "index ponderalis" of Livi (482) 1899. This is:

$$\frac{100 \sqrt[3]{P}}{L}$$

where P = weight and L = height.

Another formula takes into consideration chest circumference as well as height and weight. This was introduced by Pignet (598 and 599) in 1900 and 1901 as the "coefficient du robusticitié." It has been widely used in the German and French armies. The formula is:

$$N = H - (B + K)$$

where N = the numerical index; H = height in centimeters; B = chest circumference in centimeters; K = weight in kilograms. When the weight and chest circumference are especially large compared with the height of the individual, the size of the index is small. On the basis of this fact, Pignet divided individuals into seven classes, ranging from the group containing the best developed with a coefficient of 1 to 10, to the group including physical weaklings with a coefficient of above 35. Rarely there occurred cases of over development where the coefficient was zero or negative. Mayet (511 and 512) 1906 and 1912, applied Pignet's formula to children. A report (10) on its use with Chinese and Indian subjects was made in 1916.

Rohrer (671) 1908, emphasized the significance of the quotient obtained by dividing the weight in grams × 100 by the cube of the height in centimeters. This was called the "index der Körper-

fülle.'' Bardeen (32) 1918, used a modification of Rohrer's formula, computing an ''index of build'' by dividing the weight in pounds by the cube of the stature in inches and multiplying the quotient by 1000. This formula was applied to the data of Baldwin (29), using as a general presupposition the assumption that *a pound of the body equals a three inch cube.* As is well known in physics, the volume of objects of the same shape but of different sizes varies as the cube of their diameters. Bardeen says: ''We reach the same result by dividing the weight in pounds by the cube of a tenth of the height or by the thousandth part of the cube of the height in inches. Therefore, as a height-weight index in the study of stature, weight, and body-form, we have adopted the weight of the body in pounds divided by the thousandth part of the cube of the height in inches.'' Rohrer's formula has also been employed by Berliner (56) 1920. Davenport (199a) recommends dividing the weight by the square of the height. He unfortunately based his results on Quetelet's inaccurate data of ten cases for each age and the untenable presupposition that short children are on the average stockier. The formula is a very promising one.

In accordance with the same conception of the cubical character of the body, von Pirquet (600) 1913, stressed the height-weight index as a criterion of the individual's nutritional condition. Another formula introduced in 1916 by von Pirquet (601) used the relationship of weight and sitting height thus:

$$\frac{\sqrt[3]{10G}}{S}$$

where G = weight and S = sitting height.

Although a full consideration of formulae for volume, specific gravity, density and cubical content of the body is undesirable in this survey, mention should be made of the work of Braune and Fischer (117) 1889, Mies (525) 1899, Wengler (869) 1906, Kastner (423) 1911-12, Pfaundler (589) 1911-12, (590) 1916-17.

(4) *Growth in Surface Area.* It is beyond the scope of this investigation to enter into a full account of the subject of the *surface area* of the body of normal growing children; but reference should be made to a few of the most significant studies, since there is a direct relationship between cutaneous surface and volume and a direct relationship between volume and linear growth and also weight. The surface varies with shape and volume. A student of Vierordt, Meeh (514) 1879, assuming that individuals were similar

in shape, and disregarding the differences between infants and adults, proposed the formula:

$$S = K W 2/3$$

where S = area; W = weight; and K = a constant based upon the experimenter's data. Seaver (743) 1909, found that a determination of the superficial area of a person which may be of value for special purposes may be found in square centimeters:

$$\text{Sq. cms.} = 11 \times \sqrt[3]{\text{weight}^{-2}} \text{ (in grams)}.$$

A general survey of work on the determination of body surface was given by Lissauer (480) 1903. Other significant studies are those of von Hösslin (398) 1888, Miwa and Stoeltzner (529) 1898, Sichoff (753) 1902, Maurel (510) 1904, and Lassablière (465) 1910. Moleschott, Vierordt and Lissauer calculated areas topographically on geometrical principles or used coverings of millimeter paper or tinfoil and measured the amount of covering used, or covered the body with color and transferred the color to absorbant paper and calculated the amount of paper covered. Pfaundler (590) 1916-17, used plaster strips in a similar manner. He (589) also gives a good historical resumé. Howland and Dana (400) 1913, have used for infants the formula:

$$Y = 0.483X + 730$$

where Y = body surface in square centimeters; X = weight in grams. Du Bois and Du Bois (220 and 221) 1915 and 1916, and Sawyer, Stone and Du Bois (694), disregarding weight and volume, have made the most extensive, empirical studies, summarizing the literature of the field. They allowed for the spherical nature of the head, the cylindrical form of the neck, legs and arms, and the cylindrical or spherical tendencies of the trunk at different ages. Benedict (50) 1916, used the silhouette photographs similar to the method worked out by others. Bardeen (32) 1918, using linear measurement, weight and volume, assumed the specific gravity of the body to be 1.000 when dealing with centimeter-gram units and compared the body with a square cross section block. The formula is:

$$S = K\left(2\frac{W}{H} + 4H\frac{W}{H}\right)$$

where S = surface-area, W is weight in grams, H height in centimeters, and K is a constant. In the formula, $\frac{W}{H}$ gives the surface area of each end of the block, $H\frac{W}{H}$ the surface-area of one

side of the block. K has to be determined from the observed surface-area of the individuals, of given height and weight. If inch-pound units are used, one must substitute W × 27.68 for W in the formula given above if the same specific gravity is assumed as in this formula, or W × 27 if one assumes the same specific gravity assumed in dealing with volume. K varies with age, sex and nutritional condition of individuals. For example, for a six months infant, K = 1.53. Bardeen also gives the *regional distribution of surface areas.*

(5) *Graphic Representations of Growth.* Closely associated with the introduction of formulae expressive of total or partial growth has been the development of graphic diagrams and charts designed to show on a comparative basis with standards, the physical condition of the person or group of persons. Graphic anthropometry probably originated prior to Quetelet, who showed in graphic form the binomial distribution curve with the mean for specific measurements. Among the investigators who have developed "charting" of physiological traits are: Galton (283 and 284) 1884, 1885, who first showed the significance of percentiles; Stieda (781) 1882-83, whose work was largely theoretical; Sergi (748) 1886, who developed an anthropological cabinet; Bertillon (59 and 60) 1889 and 1896, and Muller (542) 1887, who were particularly interested in the identification of criminals. Jeanneret and Messerli (418) 1917, developed a photo-anthropometric method.

In America the early pioneer work in graphic anthropometry through charts and synoptic tables was developed and fostered by Sargent (689 and 692) 1886 and 1893, and Hitchcock (378-388), whose contributions appeared from 1887 on, Gulick (328-330) 1892 and 1893, Hartwell (350-352) 1893, Jackson (415 and 416) 1892 and 1893, Hastings (354 and 356) 1898 and 1902, and Seaver (743) 1909.

In France, Topinard's (822) *L'anthropologie*, with its excellent chapters on craniology, appeared in 1895. In Germany there was Friedenthal's (273) *Über Wachstum*, 1912 and 1913, and two articles by v. Lange (459 and 460) 1896 and 1903.

Among others who have developed graphic charts designed for score cards or norms of physical measurements are Wood (888-893) 1890-1918, Hanna (345) 1893, Kellogg (425) 1893, v. Pirquet (600) 1913, Baldwin (29) 1919, Children's Bureau (168) 1918, and Bardeen (33 and 34) 1920.

4. Anthropological Investigations

A. NATIONAL CONTRIBUTIONS ON RACIAL DIFFERENCES

No attempt will be made in this section of the historical summary to give an exhaustive account of the anthropological studies on the physique of different races, but note will be made of the most significant investigations classified according to their place of publication, and the tables in Part V will give the data for comparative studies in racial development for the reader who is concerned with this phase of human development.

(1) *English.* Numerous important contributions have been published in England. Brent (118) 1844, made before the British Association for the Advancement of Science a comparison of men at different epochs in different countries. In the following year tables were presented (119) showing the height, weight and strength of man. Quetelet (629 and 630) 1846 and 1847, presented a study of some Ojib-be-was Indians, in 1848 (631) a discussion on the Egyptians, Romans and Indians and in 1854 (632) a study of the proportions of the black race.

Thomson (816) in 1853 published some observations on New Zealanders. In 1861 Beddoe (44) discussed the physical characteristics of Jews before the Ethnological Society of London, in 1870 (45) reported on the stature and bulk of men in the British Isles, and 1897-98 made a study with Moore (537).

Other important articles are by: Shortt (751) 1863, a comparative study of Europeans and some natives of India; Brigham (124) 1866, a study of Chinese. Farr (245) 1880, and Galton (284) 1884-85, data on the English race; Forbes (257) 1884-85, on the Kubers of Sumatra, Garson (290) 1890, further data of the anthropometric committee on which Farr and Galton worked; Haddon (337) 1897, comparative study on the inhabitants of Barley, Hertz; Gregor (318) 1897, comparative study of Galloway folk in Wightshire and Kirkenbrightshire; Grünbaum (326) 1897, on the physical characteristics of the inhabitants of Barington and Foxton in Cambridgeshire; Taylor (803) 1897, on the inhabitants of Checkheaton, Yorkshire; Brown (127) 1897, inhabitants of Clara Island, Ireland; Meyers (545-547) 1905-08, on Egyptians; Rasmussen (647) 1908-09, Eskimos; Orensteen (566) 1915-17, detailed individual studies of Egyptian prisoners from Cairo; Craig's (180) earlier use of this same Egyptian material in 1911; Talbot (799) 1916,

some central Sudan tribes; Seligman (747) 1917, physical characters of the Arabs.

(2) *German.* In Germany there have been fewer anthropological studies made primarily for the purpose of finding racial differences. Many anthropometrical observations have been made by members of expeditions for other scientific purposes. As examples, may be mentioned the work of Schwarz (735) 1862, and Wullerstorf-Urbair (896) 1857-59. Other studies have been made by Schultz (728) 1845, on Russian Jews and Negroes; Scherzer and Schwarz (699) 1859, Vienna; Ecker (227) 1876, Baden; Kirchhoff (438) 1892-93, comparative studies of the Germans; Stratz (787) 1898, Java; Hagen (338) 1901, Chinese; Ranke (642) 1906, Brazil; Lipiec (478 and 479) 1912, Jews; Schiff (701) 1914, Jews from Jerusalem; Weissenberg (859, 863, 866) 1895, 1909, and 1914, Armenians and Jews; Radlauer (638) 1914-15, the Somali; Schlaginhaufen (711) 1914, New Guinea; Drontschilow (218 and 219) 1914 and 1915, anthropological studies on Bulgarians; Spitzer (770) 1915, Krakau; Bartucz (37) 1916, Magyars.

(3) *American.* The Americans have recently been less interested in racial differences than in pedagogical anthropometry. The first significant study in America was that of Dickson (207) 1857, continued in 1858 (208), who made detailed statistical observations on the height and weight of the southern men. In 1866 (209) a report showed that the new American race growing out of an almost unlimited mixture of other races, compared favorably with all the races of the Old World in every point of physical development, and showed no deterioration. Other studies were made by Bowditch (112) 1890, Massachusetts women; Boas (80, 81 and 85) 1891 and 1895, physical characteristics of the Indians, 1905 (93) anthropometry of central California, 1911 (95) descendants of immigrants, 1920 (102) anthropometry of Porto Rico; Hrdlička (401 and 403) 1898 and 1899, comparison of white and colored children and 1908 (404) observations on Indians; Bobbitt (103) 1909, Filipinos; Bean (42 and 43) 1914-15, American, German-American and Philippine children; Nicholas (550) 1919, a history of physical anthropology in Mexico.

(4) *French.* In France the interest in racial differences has been a recent development. Convy's (176) 1907, study was followed by Verneau's (843) 1916 work on Africa; Roudenko (678) published in Paris 1914, a study of different portions of Siberia.

In 1915 Pittard published three studies (604-606) on the Jews and Turks, on the Jews of Dobrodja and on the races of the Balkan peninsula.

(5) *Norwegian.* The principal Norwegian investigators of this subject are A. Daae (187) 1906, and H. Daae (187-189) 1909.

(6) *Italian.* In Italy studies from the anthropological point of view have been made by Bresciani-Turroni (120) 1913, on different regions in Italy; Guiffrida-Ruggeri (296) 1915, Oriental Africa.

(7) *Russian.* Among the important Russian studies are those of Blagovidoff (76) 1886, on the Mongolian Asiatic races; and Szepessi (798) 1897, on the Magyars. So many Russian dissertations within this field are inaccessible that no direct comparison can be made here.

(8) *Japanese.* Almost the only Japanese investigations undertaken primarily from the anthropological point of view are those by Kubo (452-454) 1912-1918, on the Chinese and on the Koreans.

(9) *Dutch.* In the Netherlands contributions have been made by Nieuwenhuis (551) 1903 and Witt (884) Netherlands.

(10) *South American.* The beginning of anthropometric work in South America is represented by a study of Cassenilli (162) 1917-18, on Argentina.

B. GROWTH OF ANIMALS AND MAN

Few studies have been made on the relationship between the growth of animals and human beings, but those that have been made are significant and full of scientific data. An early contribution was published by Menard (517) 1885. Donaldson (214) 1906, made a comparison between the white rat and man with respect to the growth of the entire body, and further studies are in progress; Friedenthal (267-272) 1909 and 1911, published curves on the growth of man and other animals, indicating great similarity between man and the anthropoid ape, and in 1914 summarized much work in his large volume (274). Haustein, 1916, (359) discussed devices for representing the growth of man and animals by measurements and drawings.

C. MILITARY STUDIES

The measurement of recruits of the army and navy has always held a prominent place in the development of physical anthropometry, and several million individuals have been measured in various countries.

France. Considering first the army, it is found that the first modern study was that of Villermé (847) in 1829, who made a careful study of the height of conscripts in the French service. In 1863 Boudin (107) published a comparative ethnological study, later followed by Chervin (167) 1896, Merz (520) 1901, and Kirkoff (439) 1906.

England. Aitken (2) 1862, published studies on the growth of the young British soldier; the British Army Medical Department (125) reports for 1894, 1895, 1896, and 1901, contain important material. Myers' (546) measurements of Egyptian recruits appeared in 1906. *A Physical Census in England and its Lesson* (11) which appeared anonymously in 1918, analysed the data on drafted men in the recent war.

America. One of the earliest military studies in America was Elliott's (230) analysis in 1863, of the physical measurements of soldiers in the American army of the Potomac. The most exhaustive studies in America were those of Gould (311) 1869, Baxter (39) 1875, Sternberg (779) 1893, and Beyer (64) 1896. French (265) 1885, and Dun (225) 1887, made a special study of the police standard. In 1918 Hoffman (391) presented a study on men rejected for military service. In 1919 Ireland, Love and Davenport (412) showed the results of the physical examination of men sent to mobilization camps, and in 1920 Davenport and Love (200) discussed defects found in drafted men in the recent world war.

Germany. German military anthropometry is represented by a number of investigations from the time of Ranke (643) in 1881. He was followed by Ammon (7 and 8) 1890 and 1894, Hultkrantz (407) 1896, Brandt (116) 1898, von Schjerning (710) 1910, Kulka (455) 1912, and Drontschilow (218) 1914. Special interest has been shown in the possibility of using indices as means for the physical examination of recruits. Schwiening (738-740) 1908, 1909, and 1914, advocated the use of Pignet's formula, and Oeder (558) 1914, discussed his work. Eulenberg (242) 1910, found Pignet's formula unsuitable for individual cases. Ott (571) 1911, and Simon (760) 1912, used the formula, while Seyffarth (749) 1911, considered it useful for rapid surveys.

Russia, Italy, Norway, Denmark. Forssberg (259) 1897, Starkow (774) 1897, Yatsuta (899) 1914, made important Russian investigations. Livi's (481) Italian article appeared in 1894. In Norway

there is Koren's study (447), 1901; and in Denmark Mackeprang's (494) investigation, 1907-11.

Naval cadets. Among the important studies of naval cadets are those of Morskoi (540) 1871, Gihon (293) 1880, Cordeiro (177) 1887, Beyer (61-64) 1893-1896, Williams (881) 1902, and Solhaug (766) 1920.

5. Growth of Infants

The first studies in anthropometric measurements of infants were those of Roederer (670) in 1753, Clarke (172) 1786, and Pfannkuch (588 a) 1874.

A. TREND OF GROWTH CURVES

Quetelet's (628) comprehensive survey of human development in 1836 included the growth of babies. Just as this investigator failed to discover the sex differences in the growth of older children, owing perhaps to having determined too few points on the growth curve, so also there was no recognition of the exceedingly steep rise in the early part of the curve during infancy. Quetelet seems to have been under the impression that this curve was a straight line connecting three points for which measurements had been taken: birth, twelve months and twenty-four months. This belief in regard to the first year, at least, is expressed as follows in *Recherches sur le poids de l'homme aux differents ages*, 1833, where it states "Pendant la première année son poids s'accroit regulièrement, de telle sorte, qu'en un son poids a triplé."

B. POSTNATAL LOSS IN WEIGHT

After Quetelet's reports, the problem of determining the general trend of the growth curves was neglected for a number of years while investigators occupied themselves with the explanation of the so-called "physiological loss of weight" in the first few days of life. Chaussier is credited by many authors with having been the first to discover that infants lose weight for a few days after birth. These observations must have been made between 1815 and 1830, but nowhere in the literature is an exact reference given. One of the earliest accessible studies is by Hofmann (393) in 1849. In 1860 both Breslau (121) and v. Siebold (754) wrote on the subject. Important investigators who followed, giving particular attention to this problem, generally from a medical point of view, are: Haake

(335) 1862; Winckel (882) 1862; Gregory (319) 1871; Kézmarsky (434) 1873; Altherr (6) 1874, Krüger (451), Ingerslev (411) and also Cnopf (173) 1875, gave an historical resumé; Stoll (784) 1876; Wolff (886) 1883, and also Biedert (67) 1883, added to a mere record of the phenomenon some consideration of the factors that influence the change in weight. Wagner (852) 1884, and Townsend (824) 1887, continued the discussion of the cause of the loss. Schaeffer (697) 1896, presented a statistical analysis of causes, and Fourmann (262) 1901, a discussion of causation. They were followed in 1903 by Schulz (729); Fuhrmann (277) 1907; Heidemann (363), Hirsch (377), Rott (677), Pies (597) 1910; and Örum (568) 1914. Benestad (51 and 52) 1913 and 1914, published an excellent review of the literature and a classification of factors of causation under the head of insufficiency of metabolism. Robertson (665 and 666) 1914 and 1915, attributed the loss to mechanical shock. His work was followed by that of Bergmann (54) 1916, Schick (700) 1917 and Hammett (344) 1918, the last of whom found the loss to be a function of birth weight. Other recent writers are Kirstein (441 and 442) 1917 and 1918, Haverschmidt (360) 1917, and Ramsey and Alley (641) 1918.

Many of these writers noted simply the phenomenon of loss by daily weighing of infants. Others attempted to account for the loss by an analysis of the physical and mechanical factors influencing weight, and the development of a better technique of weighing with reference to time of day, consumption of food, loss of organic products, etc. As a lengthy discussion of these factors is beyond the province of this work, reference should be made to the thorough treatment by Benestad (52).

C. GENERAL VS. INDIVIDUAL METHODS FOR STUDYING WEIGHT AND HEIGHT

After the early interest in the problems of fluctuations in weight, the attention of scientific writers was turned to the determination of the general curve of growth for infants. Probably the first systematic attempt to find average weights for every month in the first year of life was made by Bouchaud (106) in 1864. This line of work was continued by Fleischmann (254) 1877, whose article is of interest historically as an early example of the "individualizing method" with its insistence upon following the same individuals throughout the period observed, instead of making a few determin-

ations and interpolating values according to some formula in the manner that diverted Quetelet from the main problem. The individualizing method occurs only very rarely in the literature. Most of the workers on this problem of the total growth curve have used the method of *averages*; many have combined males and females, and practically none give average deviations.

Early writers had noted as a characteristic change in the rate of growth a general slowing down, shown by a rapid fall in the curve of increments after the first year, and had emphasized the importance of sex differences. An early study by the individualizing method was made by Woronichin (894) 1880-81. In the study of the general growth curve, the technique of the individualizing method was developed to a relatively high degree by Camerer, senior. In 1880 Camerer (144) published a short study of infant weight; in 1882 he (145) extended Vierodt's collection of cases from the literature and added data from his own practice; in 1893 he (146) reviewed the results and in 1899 his son (150) presented a summary of 283 cases. In 1901 Camerer senior (148) published the original tables for 119 of these cases. Karnitzky (422) 1908 and King (437) 1910, also reported measurements by the individualizing method on particular children.

Other much less extensive studies by the generalizing method were published as follows: Odier (554) 1863; Uffelmann (830) 1881; Pfeiffer (591) 1884; Morse (539) 1886-87; Chaille (164) 1886-87; Petersson (588) 1887; Lorey (486) 1888; Voute (851) 1895-96; ten Siethoff (757) and Graanboom (312) 1899; Perret and Planchon (587) 1904; Ausset (22) 1904; Fleischner (255) 1906; Lascoux (464) 1908; Heubner (375) 1911 (general summary); Friedenthal (270) 1911; Mayet (512) 1912; Pooler (609) 1913; Robertson (669) 1916; Broudic (126) 1919; and Faber (244) 1920. A recent undated collection of measurements by Crum (185) contains fairly reliable assembled average standards beginning at six months.

The early literature contained very few studies on the height of infants. In 1860 von Siebold (754) gave the birth length, together with the weight, but it was not until 1881 that a table by Hess (374) included a few determinations of height in the continuous series of measurements of a child from birth to two years. Schenk (726) 1880 gave the birth length of 300 cases, and Mrs. Hall (342) 1896-97, gave height measurements for one case thoughout one year.

Camerer almost always reported height as well as weight in his studies. Fleischner (255) 1906, related weight to height and other measurements. Lascoux (464) 1908, Mayet (512) 1912, and Crum (185) gave height measurements. Breslau (122) 1862, was interested in sex differences in head circumference. Of special studies concerning the interrelationship of various measurements during growth, that of Zeltner (909) 1911, is an example. In 1914 Montague and Hollingworth (530) made a comparative study of the variability of the sexes at birth and found no inherent sex differences.

D. INFLUENCE OF NUTRITION ON GROWTH

In addition to these general investigations of growth in weight and height, a number of significant studies were made on the effect of special conditions, among which diet early received scientific consideration. The first work upon this phase of the subject seems to have been done by Coudreau (178) 1869. He was followed by Faye (247) 1874, and by Ahlfeldt (1) 1878. The individualizing method was used in this field by Camerer and Hartmann (153) 1878. Their work furnished determinations actually made (and in a few cases calculated) for every day of the first year of an individual infant's life. This new point of view is exemplified also in the study of Hähner, (339) 1880, who weighed an infant before and after each feeding to determine the exact amount of food taken, with the resulting effect on growth during the first year.

The problem of the relative advantages of breast and artificial feeding came to the foreground in such work as that of Russow (680) 1881 and Sakuragi (685) 1908. Philippson (596) 1913, gave weight curves for artificially fed infants, and Sieveking (758) 1914-15, published tables for both the breast and artificially fed. Contrary to Russow's findings in regard to the superior development of breast fed infants, Hillenberg (376) 1912-13, and Variot and Fliniaux (840) 1914, reported only a small difference between the breast fed and the articially fed.

For the numerous articles on the caloric requirements of infants, Oppenheimer's (565) 1901, may serve as an example. Other works on the relation between nutrition and growth have been published by Rübner (679) 1909, Mühlmann (541) 1910, Langstein (462), Meyer (522) and Schloss (717)—all 1912; Bamberg (31), Brady (115), Herman (367), Jaschke (417) 1913; Opitz (562)

1914, Schute (731) 1915. Within the last few years a fertile field of investigation has been opened by the discovery of the special growth-stimulating properties of certain diets. Hammett and McNeile (343) 1917, observed the effect of the mother's ingestion of dessicated placenta in hastening the infant's recovery from the postnatal decline in weight.

The work of Daniels and Byfield (195 and 141) 1919-20, showed the effect of the anti-neuritic vitamin in stimulating growth. Among general treatises on the relation between nutrition and growth processes, both normal and pathological, might be mentioned those of v. d. Bergh (53) 1893, Marfan (501) 1899, Judson and Gittings (419) 1902, Schloss (715-717) 1910, 1911, and 1912, and Langstein and Meyer (463) 1914. The handbooks of Holt (396) and of Griffith (321 and 323) have gone through numerous editions within the last decade.

E. PATHOLOGICAL CONDITIONS AFFECTING GROWTH

Studies of the effect of pathological conditions on height made by Variot (835-837) 1907 and 1908, showed that a "dissociation of growth" might take place with a continuous increase in height, although weight was seriously affected; Freund (266) 1909, corroborated this; Birk (75) 1911, found, however, that with very young children height was unfavorably affected. Stolte (785) 1913, and Aron (16) 1914, also found height to be somewhat affected, though less so than weight.

Hess (373) 1915-17 showed the effect of antiscorbutic diets on weight in infantile scurvy. Eddy and Roper (228) 1917, stimulated growth in cases of marasmus by the use of pancreatic vitamin. The work of Daniels and Byfield (195 and 141) 1919-20, has already been mentioned. At the present time it seems probable that a significant advance in knowledge concerning growth is shortly to be made in this field.

F. INFLUENCE OF SPECIAL CONDITIONS ON GROWTH

Among other special conditions whose relation to growth has been studied, are *dentition*—Woronichin (894) 1880-81; *military fitness of father*—Schmid-Monnard (718) 1892; *institution vs. family life*—Freeman (264) 1914; *season*—Bleyer (77) 1917; *war conditions*—Brüning (129) 1918, Pollak (608) 1918, and Hoffman (392) 1918.

A number of writers have reported birth measurements in relation to special problems. Among these are: *the age of the mother*—Hecker (361) 1865; Faye and Vogt (249) 1866; Stockton-Hough (783) 1885-86; Lange-Nielsen (461) 1918; *nationality*—Okamato (560) 1894; Robertson (667) 1915; *order of birth*—Siesel (756) 1905; *occupation and social class of parents*—Letourneur (472) 1897; Issmer (413) 1899; Fuchs (276) 1899; Weissenberg (861) 1908; Goldfeld (307) 1912; Peller (584) 1913; *length of pregnancy*—Astengo (19) 1905; Christofferson (170) 1905; Lutz (489) 1912; Kjolseth (443) 1913; *correlations of measurements*—Pearson (576) 1900; Peller (585) 1917; and Taylor (805) 1918.

Birth measurements have also been reported by Scanzoni (695) 1849, Veit (842) 1855, Hecker (362) 1866, Martin (503) 1867, Cnopf (173) 1871, Witzinger (885) 1876, Schütz (732) 1881, Spiegelberg (767) 1882, Kézmarsky (434 and 435) 1873-1884, Körber (446) 1884, Schröder (727) 1886, Mies (524) 1891, Miller (527) 1893, Sfameni (750) 1901, Warren (857) 1917.

G. FOETAL GROWTH

Considerable work has been done on foetal growth, but this problem is beyond the province of our present discussion and the reader is referred to Jackson (414) 1909, and Scammon's unpublished work.

6. National Contributions on Phenomena of Total Growth or Partial Growth

Studies on the general phenomena of physical growth as surveyed from the early work of Bird (74) 1823, may be differentiated into innumerable problems and sub-problems. In the main the object has been to determine how children and adults grow and what is the relation of the growth of different parts to the total growth of the body.

A. NATIONS CONTRIBUTING

(1) *Belgium.* As previously stated, the first attempt at an inductive study based on empirical material was that made by Quetelet, who selected ten individuals for each age and from whose data, published 1830 onward, a number of conclusions were drawn, many of which were untrue. Since Quetelet's time there has been

little continuation of the anthropometric interest except in the work of Schuyten (733 and 734) 1902-03 and 1919.

(2) *France.* In France Buffon's (134) wide interest in scientific subjects summed up in his *Oeuvres complètes,* published 1829-32, even led to some observations "sur l'accroissement successif des enfants." Guéneau de Montbeillard "mesuré de 1759 à 1776" is probably the first child mentioned in the literature to whom the individualizing method was applied. One of the earliest statistical studies was by Silbermann (759) 1856, who reported the height of 511 Frenchmen. After this no important work appeared until Godin (298-305) began studies which were published at irregular intervals between 1893 and 1914. Further contributions have been made by Binet and Vaschide (73) 1897, Dotcheff (216) 1901, Chaumet (166) 1906, Variot and Chaumet (838) 1906, and Camescasse (154) 1918. The growth of children has also been discussed by Dufestel (224) 1907, Ganjoux (288) 1900 and Devraigne (205) 1914.

(3) *England.* Forbes (258) 1836, in England, verified the general trend of the Quetelet Belgian curves. Danson (196) 1862, made an early study on growth in weight and height using as subjects 4800 prisoners in the Liverpool jail. This was, of course, a selected group, but was probably the only large body of individuals available at that early period. Steet (775) 1874-76, compared the development of boys between 13 and 20 years of age.

The first comprehensive program for the scientific study of physical growth was formulated and carried out under the initiative and direction of Roberts, Galton and the British Association for the Advancement of Science. Roberts (661) began the study of physical development in 1874-76, investigated the physique of factory children in 1876 (662), and made subsequent studies in anthropometry, publishing his excellent *Manual of Anthropometry* (663) in 1878. Galton (279) published an early study on weight and height of boys in 1873, and began his work for the Anthropometric Committee of the British Association for the Advancement of Science in 1875. Studies were published (280) in 1881, (281) in 1883, and (284) in 1884-85, a work on the heredity of physical qualities appearing in 1885 (285) and 1886 (286). Other English studies have been made by Stephenson (777) 1887, (778) 1888, Lane (458) 1892, Maclaren (495), 1895, Lee and Pearson (468),

1901. Kay (424) in 1904 contributed valuable statistics on Glasgow school children.

(4) *Germany.* One of the first German articles on the physical development of children was that by Brunniche (130) 1866. As early as 1877 Vierordt (844) published in Germany an important treatise amplified in 1881, on the growth of the body and its parts, a point of view which has been consistently emphasized and which characterizes the most modern books of Daffner (193) 1902, Ranke (644) 1894-1900, Weissenberg (865) 1911, and of Hoesch-Ernst and Meumann (241) 1906. Kotelmann's (449) first investigations bearing on hygiene were published in 1879; Hensen (365) 1881, discussed the subject from a physiological point of view; Daffner's work began to appear in 1884 (190 and 191) and was continued by a publication of 1892-93 (192). Two studies on the growth of boys by Landsberger (456 and 457) appeared in 1888. Weitzel's (867) measurements of girls were published 1890-91 at the same time as Wiener's (879) individual study.

Other important studies have been made by Carstädt (160) 1888; Hasse (353) 1891; Schmidt (724) 1892; Camerer (146) 1893; Weissenberg (859) 1895; Hergel (366) 1897; Monti (532) 1898; Salomon (686) 1898; Schmid-Monnard (722 and 723) 1900 and 1901; Rietz (657) 1903; Reuter (653) 1903; Ranke (645 and 646) 1905; Stratz (788-794) 1908, 1909, 1911, 1912, 1914 and 1915; Schwerz (736 and 737) 1911 and 1912; Wagner (853) 1911; Ascher (18) 1912; Peiper (582 and 583) 1911 and 1912; Cohn (174) 1912; Riedel (656) 1913; Münch (544) 1914; Skibinski (763) 1914; Matusiewicz (508) 1914; Guttmann (334) 1915; and Schlesinger (713 and 714) 1917.

An important collection of tables from various sources was published by Vierordt (846) in 1906. Bachauer and Lampert (23) 1919, proposed a comprehensive program for a system of measurements on children.

(5) *Russia.* In Russia much valuable anthropometric work has been done, but as previously stated, only a limited number of investigations have been accessible, and no doubt during the last few years a large number of these may have been destroyed. Many valuable studies are in the form of Doctor's dissertations which are filed in the archives of various libraries and have been referred to principally through the work of Sack and Wiazemsky, who seldom give the exact title, number of pages, date or place of publication.

Vassiliev (841) published an early study on girls, 1881. In 1882 Dudrewicz (223) made anthropometrical measurements of children in Warsaw; Diek (210) 1883, made a more comprehensive study and in 1886 Belaiew (47) studied the children of Simbirsk. Other studies are as follows: in 1887 Suligowski (796) pupils in Radom; in 1890 Sograf (765) in Jaroslav, Kostroma and Vladimir provinces; in 1890 Milailow (526) Moscow; in 1892 Grinevski (324) Odessa; in 1892 and 1893 Sack (681-684) Moscow; in 1894 Vinogradorsk-Lukersk (849) general study of high school pupils; in 1895 Matveyeva (509) St. Petersburg; in 1896 Tezyakoff (809) in Yelisavetgrad County; in 1900 Rostovtsev (674) in Dmitrovak; in 1902 Bondyrew (105); in 1903 Karnikki (421); in 1905 Pismenniry (602) Serpukhor County. Gundobin's (331) book on the characteristics of childhood, was published in 1905, Wiazemsky's (878) Paris dissertation on physical growth of Russian children appeared in 1907, Berlinerblau's (57) study of an orphanage, Moscow, 1908, Gruzdeff's (327) 1912, and Gorokhoff's (310), 1916. Anutschin's (14) general study of the male population of Russia and Mereshoffsky's (518) on the development of children, appeared prior to Sack's dissertation, 1892, where they are cited without dates.

(6) *Italy.* In Italy an early investigation from the sociological point of view was made by Pagliani (573 and 574) 1875-76 and 1879. The Bertillon (59 and 60) system of criminal measurement was described in French in 1889 and in English in 1896. The chief pedagogical studies have been made by Santori (688) 1907, and Montessori (531) 1913.

(7) *China and Japan.* An anthropometric study of Chinese students was made by Merrins (519) 1910. With a view to developing norms for the Chinese race, the Medical Missionary Association has initiated anthropometric investigations, the first results of which were reported by Whyte (875-876) 1917 and 1918. Pyle (625) published in America, 1918, a comparison between American and Chinese children. In Japan three very important studies have been made by Miwa (529) 1893, of individuals from three to 80 years; Misawa (528) 1909, made a study of 869,014 children; and Hatta (358) recently made a report on 786 Japanese boys. A comparative study of Japanese and Chinese children appeared in 1903, by Wood (887). At the American University at Pekin, Cowdry is beginning work under the direction of the Smithsonian Institution at Washington.

(8) *Spain.* Little work has been done in Spain, but reference should be made to the work of Arthaud (17) in 1895.

(9) *Norway, Sweden and Denmark.* Studies of the growth of the Scandinavian people have been made in Norway by Faye (248) 1914, Schiötz (704-709) 1917, and Zeiner-Hendriksen (903 and 904) 1918 and 1920; in Sweden by Wietlind (880) 1878, Törnell (823) 1909, and by Sündell (797) 1917. In Denmark the years 1907-11 saw a number of investigations by Hansen (347), Rambusch (640) and Hertz (371).

(10) *Netherlands.* In the Netherlands a study of the height of males was made in 1910 by Bolk (104); a more general study of the male population in 1916 by Benders (49); and an investigation of the weight of children by Van der Loo (485), 1919.

(11) *Finland.* In Finland an important study by Oker-Blom (561) appeared in 1912.

(12) *America.* (a) School Children. The interest in pedagogical anthropometry which has had such an influence on school administration probably began in America with Bowditch's (109 and 110) reports to the Massachusetts Board of Health, 1875 and 1879, in which were analysed the statistics on thousands of school children to show the influence of nationality and social class. Equally fundamental for the establishment of the new concept of the growth process were reports on the physique of women (112) 1890, and on the growth of children studied by Galton's percentile grades (113) 1891. Later work was that of Peckham (580 and 581) 1881 and 1882, whose reports to the Wisconsin Board of Health included many valuable statistics on growth. In 1887 Stephenson (777) published a brief account of the rate of growth in children. Greenwood's Kansas City studies (317) 1890 to 1892, gave the height and weight of a large number of children. Boas' (82) Worcester study, 1892, discovered some important differences in the growth of young and older, and of tall and short children. Jackson (415) in 1892 published tables of the measurements of Easthampton students. Barnes's (35) California study, 1892-93, showed that Oakland children surpassed in physical development children from other localities studied up to this time. Moon (533-535) presented brief studies of Maryland boys, 1892 and 1896. Porter's (611-615) St. Louis studies appeared 1892 to 1894.

In 1893 and 1894 West (870-872) made some important observations of the growth of the head, body and face of Worcester, Mass.,

school children. Seaver (742) 1895-96, presented some new anthropometrical data. Boas' (84) conclusions about the advantage in growth held by first-born children resulting from an analysis of the Oakland and Toronto data were published in 1895 and subsequent findings (88) in 1897. Burk (136) published in 1898 a good summary and comparison of previous work on growth. Boas and Wissler's (100) elaborate collection and analysis of statistics on growth appeared in 1904. Gardiner and Hoagland (289) 1903, discussed the growth of California children. Robertson (669) further analysed the Oakland statistics in 1916. Holt's (397) comparative study appeared in 1918.

(b) College Students. In the standardization of anthropometric methods and instruments and in the securing of reliable data for the establishment of standards and norms, the physical training departments of colleges and universities have contributed substantial scientific data. The study of college students was begun at Marlborough College in 1874, by Fergus and Rodwell (251). In 1888 Hitchcock (380-388) started important studies at Amherst College. which were continued through 1893. Tuckermann (825) published some of the Amherst data in 1888. Seaver (741) 1889, issued a table of percentile values for fifty different measurements on Yale students ranging between 16 and 21 years of age. Sargent at Harvard has been working for years in an effort to determine the proportions of the typical man (690) 1887, scholars and athletes (693) 1908, and the typical woman (691) 1889. A series of charts (692) summing up these measurements appeared in 1893. At Wellesley College, Wood (888-892) 1890 to 1903, published tabulated data on the physical development of college women and Enebuske (235) 1894, gave measurements of normal school students of physical training. There followed investigations at Bryn Mawr by Hurd (408) 1891, and by Foster (260) 1898; at Oberlin by Hanna (345) 1893; at Haverford by Hall (341) 1895; at the Universtiy of Nebraska by Barr (36) 1903; at Ann Arbor by Bean (41) 1907-08; at Oxford by Schuster (730) 1911. Elson (233) 1910, presented some statistics on special students in an agricultural college.

B. PARTIAL AND TOTAL GROWTH

A number of special studies have been made on the growth of particular parts of the body, on the proportions of the body during

growth and on the correlations of different physical measurements during the years of growth. In the year 1854 this problem of proportions was discussed both by Carus (161) and by Zeising (905-908) whose work continued into 1859. In 1862 Welkner (868) investigated the growth of the head and Angerstein (9) 1865, made a general contribution to the theory of proportions.

Quetelet's (629-632) studies, 1846-1854, which have previously been classed under the head of racial differences, were continued by some general discussions (633 and 634) in 1870. There followed studies by Dally (194) 1872, Kotelmann (449) 1879, Lucae (488) 1882, Thoma (812) 1882, Oppenheimer (564) 1888, Hansen, (346) 1891-92, Anthony (13) 1894, Tichanoff (820) 1894, Richards and Little (654) 1896, Ripley (659) 1896, on the forms of the head and Boas (87) 1896, with a discussion of Ripley's article, Roshdestwensky (673) 1897, Binet (69) 1901, on the growth of head and face, Teumin (808) 1902, Manouvrier (500) 1902, Pfitzner (595) 1903, Seggel (744 and 745) 1903, Wissler (883) 1903, Röse (672) 1905, Laumonier (466) 1909, Weissenberg (862 and 864) 1909 and 1910.

Among recent correlation studies are those by Alfeyeff (4) 1912, weight, height and chest measurements; Weisse (858) 1912, chest and abdominal measurements in relation to build; Downes (217) 1913-14, trunk measurements and stature; Lêvy, Magnan and Sellet (473) 1914, height and chest circumference; Walker (854) 1915, relation of weight to body length. Baldwin has presented in this *Study*, pages 117 to 148 numerous coefficients of correlation for physical measurements.

C. PERIODS OF GROWTH

Attempts have been made from time to time by various investigators to divide the growth process into periods or stages of development. Bryan (132) 1900, has given a review of such attempts and discussed the significance of such stages in growth. It is, however, very undesirable to try to divide the years of average growth in any such manner as was attempted by Vierordt, Liharzik, Zeising or Key, since growth is a continuous process with no abrupt step from stage to stage. Individual and sex differences and variations in growth due to physiological maturity, heredity and racial, social and individual type still further complicate the problem. It is still an open question whether it will be possible with adequate data

consisting of repeated measurements on a sufficient number of children for a considerable period of time to outline such periods in the growth of normal children.

7. Conditions Affecting Growth

A. CLIMATE AND SEASON.

Few definite scientific data are available concerning the influence of season and climate on physical growth, since the problem is a difficult one to solve without consecutive measurements on the same group of individuals. In 1875 Baxter (39) made an important study for the Provost General's Bureau, which showed that the size of adult Americans is different in different parts of the United States, this being attributed to the influence of climate on growth. The best work was started by Malling-Hansen (497) 1883, in which an exhaustive and careful treatment was made of periodicity in the weight of children who were measured daily. This article was followed by an address before an international medical congress at Copenhagen on the effects of change of diet on growth at different times of the year (498). In 1886 Malling-Hansen (499) published a somewhat fantastic treatise on variations in weight coincident with variations in the heat of the sun's rays, in which it was found that for weight the greatest growth was from August to the middle of September and the least during May, June and July, while for height the reverse was true. Voit (850) 1886 and Zacharias (901) 1889, discussed these results. Vahl (832) 1884, discovered, for children in a girls' school weighed semi-annually from 1874 to 1883, that there was a greater increase in weight in summer than in winter. Schmid-Monnard (719 and 720) 1895 and 1896, found Malling-Hansen's "periods" characteristic of German children. Gray (315) 1910, published his *Diurnal Variations in Weight* as a Bachelor's thesis; Makower (496) 1914, substantiated the Schmid-Monnard thesis by a study of 400 Jewish children; Őrum (568) found seasonal variations in weight, 1914; Lentz (470) 1917, showed that for German children April, May and September were best for general health, while November and December were worst.

Hall (340) quotes Zak (Sack?) as finding height decreasing during the day and weight increasing, and Vierordt (845) found weekly or half weekly periods repeating themselves. Pittard (603)

1906, also discussed the influence of geographical *milieu* upon height. Porter's (618) investigation in 1920 shows that for American children the increase in weight is greater from June to December than from December to June.

B. EFFECTS OF WAR

In Germany, where the food shortage was especially acute, school physicians and health authorities have undertaken numerous investigations to discover whether the growth and nutrition of children were suffering. Some of these reports are documents of a political and controversial nature, but a certain number are deserving of scientific attention. The studies made in 1916 by Häberlin (336), Schlesinger (712), Lommel (483 and 484), Gohde (306) and Thiele (811) showed that no harmful effects of the food shortage had yet become apparent. Herzog (372) 1916, and Engelhorn (236) in the same year, even claimed war children to be in somewhat better condition, probably because of the war time emphasis on hygiene and the more sensible diet. These results were confirmed for 1917 by Oschmann (570) and Lübsen (487) and for 1919 by Siegmund-Schultze (755) and Poetter (607). Other investigators showed, however, that especially during the later years of the war, bad conditions were beginning to have their effect. Kettner (429) found that as early as 1915 a decrease in the growth of children was apparent and Engelhorn (237) 1916-17, discovered that city children were in somewhat poorer condition than during the second year of the war. Davidsohn (202) 1920, found a decrease in growth and Pfaundler as reported in an anonymous editorial (12) in 1919 showed that boys and girls grew less during the war and that the average decrease in gain was more conspicuous in children of professional classes.

Among French investigations a research made by Bleyer (78) for the American Red Cross Children's Bureau showed that the children of Vienne, a manufacturing town of France, were in good condition in 1919. Du Bois (222) 1919, published some data on the children of Liége. In England Howard (399) 1919, discussed war bread and the growth of children.

C. SOCIAL STATUS

Whether the good development of children from the favored classes is due to environmental influences including diet and medical

inspection or to superior heredity is a question that cannot be settled with the data at hand. The superiority in development is the common report of investigators. As early as 1829 Villermé (847 and 848) showed that good homes and good nutrition contribute materially to physical growth. Bowditch (110) 1879, showed that the "favored classes" with good nutrition are superior to general classes, especially in height. This view was also held by Roberts (663) 1878, by the Anthropometric Committee of England under the chairmanship of Galton (281) 1883, by the Danish Commission under Hertel (368 and 370) 1882, by Geissler and Uhlitzsch (291) 1888, and by Geissler (292) 1892, by Erismann (239 and 240) in Russia 1888, and by Key (430) in Sweden, 1885. Stanway (773) 1833, published the results of investigations into the comparative health and condition of factory and non-factory children of Manchester and Stockport. Malling-Hansen's (497) study of food values in Copenhagen gave in general negative results. Pagliani's (574) Italian study appeared in 1879. Landsberger's (457) study of boys appeared in 1888. Kozmowski's (448) intensive work on the weight and growth of children of the poorer classes of Warsaw is dated 1894. From 1899 to 1902 Pfitzner (592-594) published a series of "Social Anthropologische Studien." Niceforo (549) 1903, began a study of over 3,000 children in the schools of Lausanne, classified according to social status. Koch-Hesse (445) 1905, compiled much statistical material from various investigators. Allaria (5) 1912, investigated the growth of children of the poorer classes. Young (900) 1913, found the children of the rich to be better developed than children who attended public schools. Elderton (229) 1914, classified the measurements of over 63,000 Glasgow school children in four social groups. Dikanski's (211) 1914, arrangement of Hoesch-Ernst's material showed better physical development with rising social class. Brezézinski and Peltyn (123) measured children of factory workmen, 1914. Frankel and Dublin (263) 1916, analyzed the measurements of 10,000 children who received employment certificates in New York City during the previous year. Schlesinger (713 and 714) 1917, again proved the superior development of the children from well-to-do families. The measurements by Baldwin (27) 1914 and this *Study*, on children of the well-to-do class are on the whole extremely high.

D. CITY VS. COUNTRY LIFE

Although many studies of school children in and around certain cities would probably permit of comparisons of the physical development of city and country children, if the original data were at hand, there have been few studies undertaken directly for this purpose. The question of stature in the city and country population was discussed by Quetelet (626) in 1830. Galton (279) 1873-74, and Peiper (583) 1912, found country boys to be both taller and heavier than city boys. Baldwin (28) 1916, obtained results that were in agreement with this, inasmuch as it was found that country boys mature earlier than city boys. Pyle and Collings (624) 1918, found that there was a slight difference in favor of city children. Urick (831) 1918, presented statistics on city and country children in Iowa.

Doubtless the War Departments of various countries are in possession of much material on this point, but little has been published. The statistics of men drafted in the United States during the World War, which were analyzed by Davenport and Love (200), showed that 61.74% of urban men were accepted without defect, rural 66.74%, and that 33.49% of urban men were accepted with defect, rural 28.30%.

E. HYGIENE AND EXERCISE

A great deal of work on physical growth has been approached from the point of view of hygiene. Measurements of children have often been undertaken in order that school desks might be better adjusted to the physique of the children. Other studies, especially in Germany and Russia, have been made with the purpose of ascertaining the effect of school conditions on the physical development of children. A third group deals with the effect of exercise, physical training and college athletics. Other investigations are concerned with general health, diseases and physical defects.

Many of the references on physical hygiene are classified under other specific subjects, since the field is comprehensive and indefinite, but those of particular import limited to the influence of hygienic conditions are: Hutchinson's (409) 1846, and Pagliani's study (573) 1875, with particular reference to breathing capacity; Roberts' (662) factory report, 1876, and his memorandum on medical inspection (660); Kotelmann's (449), 1879, study on the influence of physical training; Bruun's (131) study in hygiene, 1887;

Geissler and Uhlitzsch's (291) study on fitting school desks, 1888; Kellogg's (426) strength studies, 1896; Porter's (616 and 617) 1896, measurements in schools; Taylor's discussion of the influence of exercise upon length of life (804) 1897; Burk's (138) *Influence of Exercise*, 1899; Bürgerstein's (135) *Schulhygiene*, 1902; Hastings' (357) *Health and Growth of School Children*, 1903; sketches of English school children by Thomas (815) 1905; Zahor's (902) Prague study, 1907; Tyler's general articles (828 aand 829) 1907 and 1908; Harrington's (348) *Health and Education*, 1910; Wright's (895) *Post-Adolescent Girls*, 1910; Baldwin's (25Q *Notes on School Observation*, 1911; Pyle's (622 and 623) manuals of 1913 and 1920; Terman's (807) *Hygiene of the School Child*, 1914; the comprehensive investigations by Tuxford and Glegg (827) 1911, including 583,640 English children between three and 14 years of age; Mumford's (543) 1912, Manchester grammar school investigation; with the additional English studies of Greenwood (316) 1915, and Tuxford (826) 1917; Penn (586) 1917; and Kerr (427-428) 1918 and 1919. In Germany appeared Meumann's (521), *Experimentelle Pädagogik*, 1911; Heller's (364) studies on Salzburg children, 1913-14; Steinhaus' (776) 1913; Spitzy's (771) *Die körperliche Erziehung des Kindes*, 1914; and Matthias' (507) 1916, work on the effect of physical exercise on Swiss athletes. Laurent's (467) investigation of physical education in France; and the important Russian studies cited by Sack, *i. e.* Leshaft (471) 1879-80, Nagorsky (548) 1881, Michailoff (523) 1887, Belyaieff (48) 1888, and Zhbankoff (910) 1889.

F. SPECIAL CONDITIONS

A number of isolated investigations deal with the relation between growth and other special conditions not previously listed in this resumé. Among these is an investigation of loss of weight and gain in height during sleep, by Curtiss (186) 1898. Burk (137) in 1899 discussed the influence of sex on growth. Cailli (142) 1903, noted the effect of country living. Boas (94) 1909, published an article on civilization and stature. The work of Davenport reported in his *Heredity in Relation to Eugenics* (198) 1911, and his *Inheritance of Stature* (199) 1917, continued a line of investigation begun by Galton. Carmon (159) 1912, published a discussion of rapid changes in weight. Boas (99) 1913, traced the effect of heredity

and environment on growth. Reports on growth and dentition were made by Bean (42) 1914, and Spier (769) 1918. Stiles and Wheeler (782) 1915, analyzed physical measurements of American children from homes of good and poor sanitary condition. Camescasse (155 and 156) 1918, reported the results of an experiment in which for the sake of economy bread was replaced by rice and vegetables, with good results. In 1919 Dick (206) published in England his book on the effect of defective housing on growth. Powys (621) 1902, and Harris (349) 1920, have noted the decrease in stature in later adult life. Retan (652) and Emerson (234) have been particularly interested in the relation between nutrition and physical development.

8. Special and Abnormal Phases of Growth

A. PATHOLOGICAL

A limited number of good scientific studies has been made on the relationship between growth and disease. In 1881 Bowditch (111) asserted that the "normal rate of growth would not only throw light on the diseases to which childhood is subject, but would also guide us in the application of therapeutic measures." One of the earliest treatises was by Regnier (650) 1860. Then came Auboyer's (20) work in 1881. Hertel (368) 1882, published the report of the Danish Commission including measurements of 17,595 boys and 11,646 girls. In 1885 appeared his *Overpressure in the High Schools of Denmark* (369), and in 1888 a comparison between the findings of the Danish and Swedish Commissions (370). Key's (430) important Stockholm study appeared in 1885 and the German edition in 1889; Michailoff's (523) Russian study, 1887; Springer's (772) 1890; Carlier's (158) 1892; Bézy's (66) 1894; Combe's (175) investigation in Lausanne, 1896; Warner's (856) comprehensive English study, 1897; Schmid-Monnard's (721) German study in 1897; Ranke's (646) German study, 1905; Camerer's (151) investigation of malnutrition, 1905; Gundobin's (331 and 332) Russian investigation, 1905 and 1907; Holmgren's (395) article on the influence of Basedow's disease on stature, 1909-10. Other important contributions are Camerer's (152) general account of growth in relation to disease, translated 1908; Baldwin's (25) *Notes on School Observation*, 1914; Chose's (169) 1914 work on rachitis and growth; Thiele's (810) 1915 on tuberculosis; Schiötz's (702 and

703) articles on growth and disease, 1915 and 1916; and Strong's (795) study of the effect of hookworm, 1916. Many general texts on children's diseases contain chapters on growth. Among those not previously mentioned is that by Feer (250) 1911. Kötz (450) 1918-19, discussed the phenomena of unequal growth of the two sides of the body, and Thoma (814) 1918, the conditions that interfere with the growth of the head.

B. MENTAL ABNORMALITY

From the standpoint of developing standards for the physical growth of normal boys and girls, valuable facts have been obtained through comparison with the growth of feeble-minded children. The first study dealing with the physical growth of idiots and imbeciles (mentally deficient children) was published by Roberts (663) in the manual on *Anthropometry*, in 1878. The investigation, which was probably made in 1871, included the height and weight of 829 children and adults between the ages of three and 15 years. from the asylums in England, without differentiating between the sexes. In 1877 Shuttleworth (752) published in America a very good paper on the growth and mentality of feebleminded children. Tarbell's (801 and 802) studies appeared in England, 1876-86 and 1888-89. Wylie (897 and 898) 1899 to 1903, made careful studies of 400 boys and girls from Minnesota and concluded that feebleminded children were subnormal in physical development, while Macdonald (490) 1897-98, also found children with abnormalities inferior in growth to children in general. Binet's (68-71) significant studies appeared in France in 1900 to 1910. A later book with Simon (72) was translated, 1914. Simon's (761 and 762) studies appeared 1899 and 1900; Vaney's (833 and 834) 1906-1909, and Martin's (504) in 1912. Norsworthy (553) 1906, could find no distinguishable differences between the physical development of feebleminded and normal children compared with the Boas and Bowditch standards. Guttmann (333) reported comparative measurements of normal and abnormal children in 1906. Goddard (297) 1912, has made the most valuable and painstaking study within this field, having recorded measurements on 10,000 children at the Vineland Training School in New Jersey and at eighteen other institutions in America. Doll (212) 1916, used the psychophysical measurements of right and left grip and lung capacity as diagnostic criteria of feeblemindedness, and Porteus (619) 1919-20,

has been making careful studies in cephalometry of the feeble-minded children at Vineland.

Among the special studies of physical development of the insane, should be mentioned Boyd's (114) 1861, studies on 2614 post-mortem examinations. Goodall (308 and 309) 1898 and 1901, compared the development of the insane and the abnormal. The physical development of delinquents has not received much attention, though several medical studies have been made. The best work in the anthropometric field is that by Marty (506) 1898, and by Tallant (800) 1912.

9. Physiological Age

A. ADOLESCENT GROWTH

One of the most important present-day problems in physical growth from the standpoint of the educational, social, religious and psychological development of the child centers around the question of physiological age, with particular reference to the development during adolescence. In his early work, 1890, Key, (432) raised the problem of "Die Pubertätsentwicklung and das Verhältnis derselben zu den Krankheitsercheinungen der Schuljugend." In 1891 Key (433) made another contribution to the subject, as did Miwa (529) 1893. Morey-Errant (538) 1898, published a general discussion bearing primarily on puberty; Lincoln (477) 1896, published a practical paper with some good observations on sexual maturity; Moon (536) 1899, printed a short paper with a discussion of the question of growth and puberty, claiming that the latter had no effect on growth; Godin (298, 301, 302) in 1902, 1911 and 1912, published brief papers on the adolescent type, based on his 1903 study (299), with 36,000 measurements on the same one hundred subjects followed from 13 to 18 years of age. In 1902 and 1907 Wiazemsky (877 and 878) published important studies on modifications of the organism during the period of puberty. Kimpflin (436) 1914, reported measurements of 200 adolescents. Riebesell (655) 1916, proposed that weight as a function of time should be used as an index of physiological age.

B. PHYSIOLOGICAL AGE AND SCHOOL PROGRESS

The educational and sociological significance of the problem of physiological age has been championed by Bryan (132) 1900; Crampton (181-184) 1908; Weissenberg (865) 1911; Foster (261)

1910-11; Boas (98) 1912; Beik (46) 1913, and Baldwin (27 and 28) 1914 and 1916. Bean (42) 1914, reported on the relation between dentition and maturity, while Rotch (675 and 676) 910, initiated the problem of the graduations of carpal and epiphyseal development. The question of adolescence in its psychological, sociological and educational bearings, together with comparative data from various investigations on physical development, has been treated by Hall (340) in his *Adolescence,* 1904.

10. Physical Growth and Mental Development

A most significant trend of investigations on physical growth, from the writer's point of view, lies in the large number of studies dealing with the relationship between physical and mental development. Modern genetic, functional and behavioristic psychology all begin with the phenomena of physical growth. Warner's (855) 1890, very comprehensive but inaccurate study, served to initiate the problem in England. Other studies which contain material bearing on this problem, but usually not analyzed to show the exact relation between physical and mental development, have been made by Martiegka (502) 1898; Thorne (819) 1904; Berry (58) 1904; Quirsfeld (635-637) 1904-1907; Samosch (687) 1904; Eyerbibh and Löwenfeld (243) 1905; Popper (610) 1907; Arkle (15) 1908; Vaney (833-834) 1906 to 1909; and Albert and Arvizu (3) 1917. Burk (136) 1898, Oppenheim (563) 1898, Hall (340) 1904, Thorndike (817) 1901, Whipple (874) 1915, and Kirkpatrick (440) 1917, analyzed and summarized the general problem more or less extensively without original data.

A. ABSENCE OF CORRELATION

A number of investigations have shown no discernible relationship between mental and physical development. So, for example, Galton (287) 1891, in university tests found no correlation between literary ability and physical measurements. Gilbert (294 and 295) 1895 and 1897, and Cattell and Farrand (163) 1896, found no definite correlation between physical and mental tests. Radosavljevich (639) 1913, also could trace but little correlation between physical development and school brightness. The work of Pearson (577-579) 1901-02, and 1906, and of Lee, Lewenz and Pearson (469) 1903-04, showed very small and unreliable correlations between intelligence and physical characters.

B. NEGATIVE CORRELATIONS

Only one investigator definitely states a negative correlation. This is Sargent (693) 1908, who found that the "stipend scholarship men" at Harvard were among the shortest and lightest.

C. POSITIVE CORRELATIONS

The most significant pioneer study showing positive correlation was made by Porter (611-618) 1892-93, 1894 and 1896, who found that "precocious children are heavier and dull children are lighter than the mean children of the same age." Holmes (394) discussed this work in 1894 and Boas (86) in 1895. Positive findings have been confirmed or supplemented as follows: in Russia by Gratsianoff (313) 1889, and Sack (681) 1892,—in America by Hartwell (351) 1894-95; West (873) 1896; Macdonald (490-492) 1897-98 and 1910; Hastings (355) 1899; Christopher (171) 1900; Smedley (764) 1900; Beyer (65) 1900; Zirkle (911) 1902; Debusk (203) 1913; Mead (513) 1914; Grover (325) 1915; Donaldson (215) 1915; Stewart (780) 1916; Busk (140) 1917; Courtis (179) 1917; and Baldwin (25, 27 and 30) 1911, 1914 and 1920,—in Germany by Schmidt and Lessenich (725) 903; Graupner (314) 1904; Bayerthal (40) 1905-1910; Rietz (658) 1906; and Spielrein (768) 1916.

PART V

CHAPTER X

COMPARATIVE TABLES

These comparative tables are roughly grouped in three sections: I. Infants, II. Pre-School, III. School Children and Adults. Section I comprises children under one year, Section II those under six years, and Section III those over six years. In some cases where an investigator gives only a few measurements which should go under one section while the majority belong in another section, these age limits have not been strictly followed.

Some of the tables are continuations of tables in a preceding section. In such cases this fact is noted in the footnote. There are for Infants 59 tables, Pre-School Children 93 tables, School Children 491 tables, Total 643. Recorded number of cases 5,385,463.

The insertion of the symbol ** in a column of measurements indicates that the investigator gives some further data, usually on only a few cases and at such irregular age intervals as to make inclusion in these tables impracticable.

Within each of the three sections the tables are grouped according to the nationality of the subjects to facilitate comparisons of the measurements of similar racial groups. Within a nationality the arrangement of the names of the investigators, and consequently of the tables, is alphabetical. The columns and their descriptive footnotes are numbered consecutively, a complete number series being used for each of the following: Infants, Pre-School, Height of Males, Height of Females, Weight of Males and Weight of Females.

Each column also bears before the name of the investigator a number (sometimes joined with a letter) which will enable the reader to identify within each of the three sections the corresponding measurements resulting from the same investigation. For example, within the Pre-School Section, the figure 1 b recurring in Height of Males, Height of Females, Weight of Males and Weight of Females, is used always to designate measurements of a group of American born Bohemians studied by Boas. The figures 1 c, 1 d, etc. refer to other groups studied in the course of the same general investigation designated by the number 1. If Boas had made other investigations,

published in other articles, they would have received numbers 2, 3, 4, etc. This system for the identifications holds only within a section. A new series has been constructed for Infants, for Pre-School and for School and Adult. It is possible, however, to trace the same investigation throughout the different sections by referring to the footnotes.

Each column of measurements has a footnote giving the date of publication, the place where measurements were made, and such other information as could be obtained about the subjects, their social group, nutrition, race, school status, and number. In the footnote is also given the bibliography number of the article or book in which the investigation is published. The serial bibliography numbers correspond to the alphabetical arrangement of the contributions of a single investigator. References which deal primarily with work on infants under one year are designated by starred numbers in the bibliography.

I. INFANTS

HEIGHT OF MALES IN CENTIMETERS

	American				French		German	
Age in Weeks and Months	1. Baldwin[1]	3. Crum[2]	4. Freeman[3]	5. Holt[4]	9a. Variot and Fliniaux[5]	9b. Variot and Fliniaux[6]	10. Friedenthal[7]	11. Schmid-Monnard[8]
Birth	52.4			52.5				
1								
2								
3								
4								
1 mo.	53.8		54.9		53.0	52.8	54.8	50.6
5								
6								
7								
8								
2 mo.	57.9				57.3	56.6	58.4	54.1
9								
10								
11								
12								
13								
3 mo.	60.5		62.3		59.0	58.6	61.4	55.6
14								
15								
16								
17								
4 mo.	62.8				61.5	61.2	63.4	59.9
18								
19								
20								
21								
5 mo.	64.8				63.2	62.8	65.0	60.5
22								
23								
24								
25								
6 mo.	66.6	67.3	67.4	67.3	65.5	64.0	66.5	63.0
7 mo.	68.4	69.2			66.0	65.2	67.5	64.4
8 mo.	69.3	70.2			67.0	66.5	69.0	66.1
9 mo.	70.6	71.4	73.4		68.2	67.5	70.5	67.4
10 mo.	71.9	72.4			70.0	68.2	72.0	65.9
11 mo.	72.6	73.7			70.7	69.5	73.0	69.6
12 mo.	73.8	74.6	77.1	75.0	72.0	71.0	74.0	71.0

HEIGHT IN CENTIMETERS

	Females									Males and Females		
	American				French		German		Amer.	German		
Age in Weeks and Months	1. Baldwin[9]	3. Crum[10]	4. Freeman[11]	5. Holt[12]	9a Variot and Fliniaux[13]	9b Variot and Fliniaux[14]	10. Friedenthal[15]	11. Schmid-Monnard[16]	12. Fleischner[17]	19. Camerer[18]	21a. Russow[19]	21b. Russow[20]
Birth	53.9			52.0					53.3	52		
1												
2										52	51.0	49.0
3										55		
4										57		
1 mo.	53.3		54.8		53.0	52.7	53.0	50.1	56.6		55.0	53.5
5										56		
6										58		
7										60		
8										55		
2 mo.	56.2				55.6	56.5	56.0	53.8	60.5		58.0	56.5
9										59		
10										59		
11										56		
12										63		
13										61		
3 mo.	58.9		61.0		58.0	57.6	58.0	51.5	62.7	61	61.0	58.0
14										63		
15										62		
16										60		
17										63		
4 mo.	61.2				60.5	60.5	60.0	59.3	64.0		63.0	60.0
18										65		
19										65		
20										66		
21										66		
5 mo.	63.4				62.0	51.5	61.5	61.0	66.0		65.0	62.5
22										67		
23										65		
24										70		
25										66		
6 mo.	64.4	65.7	65.8	66.0	64.0	63.5	63.0	62.2	68.1	68	67.0	64.0
26												
27										70		
28												
29										68		
30										70		
7 mo.	67.1	67.3			65.0	64.5	64.5	64.0	68.6		68.0	65.0
31										69		

32										73		
33										71		
34										71		
8 mo.	68.6	68.6			66.0	66.0	66.5	64.9	69.6		68.5	65.0
35										67		
36												
37												
38												
39												
9 mo.	69.4	70.2	70.9		68.0	67.0	67.5	66.9	70.4		69.0	67.0
40										75		
41										75		
42										66		
43										70		
10 mo.	70.2	70.8			69.8	68.0	68.5	67.0	71.6		70.0	67.5
44										73		
45										78		
46										69		
47										72		
11 mo.	71.4	72.1			70.5	69.5	69.5	67.0	72.9		71.5	68.5
48										75		
49												
50												
51												
52												
12 mo.	72.0	73.3	75.5	73.7	71.5	71.0	70.5	68.1	73.9	76	73.0	69.0

WEIGHT OF MALES IN GRAMS

Age in Weeks and Months	American						English			Danish	French		German	
	1. Baldwin[21]	2a. Baldwin[22]	2b. Baldwin[23]	3. Crum[24]	4. Freeman[25]	5. Holt[26]	6a. Robertson[27]	6b. Robertson[28]	7. Robertson[29]	8. Örum[30]	9a. Variot and Fliniaux[31]	9b. Variot and Fliniaux[32]	10. Friedenthal[33]	11. Schmid-Monnard[34]
Birth	3996	3629	3408		3552	3430								
1		3827	3473											
2		3799	3558											
3														
4		3969	3924							4150				
1 mo.	4154				4110		4394	3317	4169		3600	3582	4250	3451
5														
6		4479	4088											
7														
8		4848	4584							4960				
2 mo.	5149						5301	3997	4790		4330	4290	4950	4108
9														
10		5075	4950											
11														
12		5358	5165							5590				
13														
3 mo.	5923				5824		5840	4791	5493		5030	4820	5600	4840
14		5642	5162											
15														

16		6038	5591							6175				
17														
4 mo.	6493						6350	5472	6196		5670	5760	6200	5670
18		6294	5936											
20		6407	6109							6720				
5 mo.	7096						7201	6407	6627		6180	6000	6750	5868
22		6691	5973											
24		6776	6793							7200				
6 mo.	7501	7059	6926	8165	7484	7260	7654	6861	7140		6800	6380	7250	6802
28		7172	6849							7630				
30		7626	7190											
7 mo.	8025			8675			8136	7569	7616		7100	6940	7750	7017
32		7541	6991							8040				
34		7853	7436											
8 mo.	8363			8959			8505	9327	7829		7620	7370	8200	7152
36		7966	7371							8400				
38		8250	7558											
9 mo.	8679			9242	8859		8817	7938	8020		8220	7500	8600	7579
40		8477	7669							8750				
42		8760	7660											
10 mo.	8949			9469			9242	8448	8496		8600	8000	8950	8312
44		8732	8051											
46		8788	8343											
11 mo.	9114			9696			9441	9129	8600		8800	8450	9200	8412
48		8817	8219											
50		9270	8386											
12 mo.	9399	9299	8423	9922	9906	9540	9355	9497	8909		8950	8810	9450	8588
54		9214	8771											
56		9440	9001											
58		10121												

WEIGHT OF FEMALES IN GRAMS

	American						English			Danish	French		German	
Age in Weeks and Months	1. Baldwin[35]	2a. Baldwin[36]	2b. Baldwin[37]	3. Crum[38]	4. Freeman[39]	5. Holt[40]	6a. Robertson[41]	6b. Robertson[42]	7. Robertson[43]	8. Örum[44]	9a. Variot and Fliniaux[45]	9b. Variot and Fliniaux[46]	10. Friedenthal[47]	11. Schmid-Monnard[48]
Birth	4252	3714	3340		3470	3260								
1		3317	3439											
2		3770	3496											
3														
4		4082	3892							3790				
1 mo.	3978				3924		4338	3402	4055		3580	3560	3850	3219
5														
6		4111	4159											
7														
8		4451	4590							4480				
2 mo.	4628						4763	3884	4522		4320	4160	4550	4002
9														
10		4763	4794											
11														
12		4904	4964											
13										5070				
3 mo.	5391				5611		5330	4423	5103		4960	4600	5200	4792
14		5245	5395											
16		5471	5299							5600				

17														
4 mo.	6041						5925	5075	5729		5360	5350	5750	5409
18		5755	5681											
19														
20		5982	5778							6120				
5 mo.	6579						6350	5216	6169		6140	5830	6300	5866
22		6265	6265											
24		6265	6124							6450				
6 mo.	6996	6520	6447	7598	7244	7030	7173	5613	6672		6720	6300	6800	6426
28		6747	6362							6850				
30		7059	6736											
7 mo.	7543			7881			7456	6010	7162		7050	6800	7350	6855
32		7258	7133							7240				
34		7172	7022											
8 mo.	7968			8278			7654	6776	7326		7580	7200	7800	6936
36		7484	7351							7625				
38		7683	7450											
9 mo.	8191			8675	8528		8505	7343	7525		8000	7450	8200	7396
40		7938	7717							7960				
42		8023	7552											
10 mo.	8339			8845			8930	7144	7747		8525	7945	8450	7527
44	8335	8083												
46		8335	7978											
11 mo.	8606			9129			9497	7513	8165		8750	8400	8700	7588
48		8647	8054											
50		8788	8304											
51														
12 mo.	8768	8902	8474	9412	9448	9310	9781	8165	8151		8900	8780	8900	7756
54		8930	8341											
56		9015	8431											
58			8375											

WEIGHT OF MALES AND FEMALES IN GRAMS

	American			French			German				
Age in Weeks and Months	12. Fleischner[49]	13. Griffith[50]	14. Holt[51]	16. Bouchaud[52]	17. Broudic[53]	18. Newman[54]	19. Camerer[55]	20. Fleischmann[56]	10. Friedenthal[57]	21a. Russow[58]	21b. Russow[59]
Birth	3266	3450	3310		3280		3433	3500	3500		
1		3360					3408				
2		3490			3350		3567			3564	3525
3		3670					3781				
4		3900			3810		4008		4500		
1 mo.	4355		3740	4000		3487		4550		4333	3914
5		4080					4199				
6		4260			4100		4422				
7		4460					4576				
8		4650			4370		4907		5400		
2 mo.	5080		4790	4700		4026		5500		4848	4569
9		4900					4958				
10		5050			4600		5227				
11		5220					5365				
12		5400					5600		6130		
13											
3 mo.	5942	5580	5620	5350	5080	4564	5693	6350		5701	5310
14		5760					5846				
15		5940					6033				
16		6080					6294		6800		
17		6240			5650		6434				
4 mo.	6623		6240	5850		5103		7000		6105	5871
18		6360					6516				
19		6490					6569				
20		6670					6824		7400		
21		6760					6962				
5 mo.	7167		6710	6500		5783		7550		6640	6042
22		6890			6250		7070				
23		6990					7251				
24		7140					7289		7900		
25		7210					7485				
26											
6 mo.	7938	7350	7120	7000	6710	6464	7505	7970		7072	6317
27		7440					7698				
28		7580					7774		8300		
29		7670					7946				
30		7770			7080		7911				
7 mo.	8029		7460	7450		6917		8330		7565	6680
31		7870					8061				

32		8000					8175		8650		
33		8070					8189				
34		8190			7400		8400				
8 mo.	8119		7670	7840		7229		8630		8102	7745
35		8300					8483				
36		8390					8655		8980		
37		8440					8746				
38		8480					8641				
39											
9 mo.	8255	8530	7850	8200	7740	7598	8674	8930		8401	7916
40		8570					8855		9280		
41		8710					8979				
42		8800					9146				
43		8890			8110		9028				
10 mo.	8845		8100	8500		7995		9200		8930	8000
44		8960					9232		9550		
45		9070			8280		9330				
46		9160					9307				
47		9230			8350		9398				
11 mo.	8981		8510	8750		8363		9450		9287	8180
48		9320					9589		9800		
49		9410			8500		9708				
50		9530					9628				
51		9640			8650		9816				
12 mo.	9480	9750	9050	8950	8770	8732	10141	9600	10000	9930	8480

I. INFANTS

1. 1920, Iowa, M 4682, see page 53. Continued in Section II as Column 82, height of males.
2. Bib. 185, about 1915, M 1644. Continued in Section II as Column 83, height of males.
3. 1920, New York, computed from data of private cases furnished by Dr. Freeman, M 194. Continued in Section II as Column 9, height of males.
4. Bib. 396, 1920.
5. Bib. 840, 1914, breast-fed, M 300.
6. Bib. 840, 1914, artificially-fed, M 492.
7. Bib. 274, 1914.
8. Bib. 718, 1892, Frankfurt a. M., breast-fed, M 823.
9. 1920, Iowa, F 4392, see page 53. Continued in Section II as Column 85, height of females.
10. Bib. 185, about 1915, F 1301. Continued in Section II as Column 86, height of females.
11. 1920, New York, computed from data of private cases furnished by Dr. Freeman, F 140. Continued in Section II as Column 37, height of females.
12. Bib 396, 1920.
13. Bib. 840, 1914, breast-fed, F 336.
14. Bib. 840, 1914, artifically-fed, F 384.
15. Bib. 274, 1914.
16. Bib. 718, 1892, Frankfurt a. M., breast-fed, F 736.
17. Bib. 255, 1906, well nourished infants. Compiled from his table of increments.
18. Bib. 148, 1901, breast-fed, M and F 119.
19. Bib. 680, 1881, breast-fed, M and F 92.
20. Bib. 680, 1881, breast- and artificially-fed, M and F 92.
21. 1920, Iowa, M 4682, see page 53. Continued in Section II as Column 88, weight of males.
22. 1920, Baltimore, white, consecutive measurements on children under medical and dietary supervision. M 100. See page 39.
23. 1920, Baltimore, colored, consecutive measurements on children under medical and dietary supervision. M 100. See page 43.
24. Bib. 185, about 1915, M 1644. Continued in Section II as Column 89, weight of males.
25. 1920, Computed from data of private cases furnished by Dr. Freeman, M 616. Continued in Section III as Column 53, weight of males.
26. Bib. 396, 1920.
27. Bib. 666, 1915, breast-fed. M 244.
28. Bib. 666, 1915, bottle-fed, M 88.
29. Bib. 669, 1916, M 1137.
30. Bib. 568, 1914.
31. Bib. 840, 1914, breast-fed, M 300.
32. Bib. 840, 1914, artificially-fed, M 492.
33. Bib. 274, 1914.
34. Bib. 718, 1892, Frankfurt a. M., breast-fed, M 823.
35. 1920, Iowa, F 4392, see page 53. Continued in Section II as Column 91, weight of females.
36. 1920, Baltimore, white, consecutive measurements on children under medical and dietary supervision. F 100. See page 37.
37. 1920, Baltimore, colored, consecutive measurements on children under medical and dietary supervision. F 100. See page 41.
38. Bib. 185, about 1915, F 1301. Continued in Section II, Column 92, weight of females.

39. 1920, New York, computed from data of private cases furnished by Dr. Freeman, F 463. Continued in Section II as Column 67, weight of females.
40. Bib. 396, 1920.
41. Bib. 666, 1915, breast-fed, F 168.
42. Bib. 666, 1915, bottle-fed, F 99.
43. Bib. 669, 1916, F 992.
44. Bib. 568, 1914.
45. Bib. 840, 1914, breast-fed, F 336.
46. Bib. 840, 1914, artificially-fed, F 384.
47. Bib. 274, 1914.
48. Bib. 718, 1892, Frankfurt a. M., breast-fed, F 736.
49. Bib. 255, 1906, computed from his table of increments.
50. Bib. 323, 1899, figures estimated from a chart.
51. Bib. 396, 1916, figures estimated from a chart.
52. Bib. 106, 1864.
53. Bib. 126, 1919, breast and artificially fed, M and F 300.
54. Bib. 669, copied from Robertson who says this English standard was derived from French infants.
55. Bib. 148, 1901, breast-fed, M and F 119.
56. Bib. 254, 1877.
57. Bib. 274, 1914.
58. Bib. 680, 1881, breast-fed, M and F 92.
59. Bib. 680, 1881, breast and artificially fed, M and F 92.

II. PRE-SCHOOL

HEIGHT OF MALES IN CENTIMETERS

	American									
Age in Years	1b. Boas[1]	1c. Boas[2]	1d. Boas[3]	1e. Boas[4]	1f. Boas[5]	1g. Boas[6]	1h. Boas[7]	1i. Boas[8]	2. Freeman[9]	3. Hrdlička[10]
Birth										
½									67.4	
1									77.1	
1½									82.7	
2									87.8	
2½									90.9	
3									98.0	78.4
3½									101.4	
4	99.4	98.0	99.0	101.2	97.4	96.3	98.0	96.5	103.9	
4½										
5	105.7	104.6	106.4	104.2	102.7	101.8	101.0	103.7	108.6	104.4
5½										
6	110.7	109.6	107.8	108.7	108.9	107.3	110.6	109.5	114.4	110.1

HEIGHT OF MALES IN CENTIMETERS

	Amer.	English					Bel.	Fren.	German			Russ.	Ital.	Japan.
Age in Years	4. Peckham[11]	5. Boyd[12]	6. Roberts[13]	7a. Tuxford & Glegg[14]	7b. Tuxford & Glegg[15]	7c. Tuxford & Glegg[16]	9. Quetelet[17]	10. Variot & Chaumet[18]	12. Daffner[19]	13. Ranke[20]	14. Schmid-Monnard[21]	15. Weissenberg[22]	16. Pagliani[23]	17. Misawa[24]
Birth			49.6				50.0		51.9	49.9	52.0	50.8		49.0
½														
1			68.6				69.9		73.8	62.6	70.2			73.5
1½		72.4						74.2						
2	75.0		85.6				79.0		85.2	77.1	81.7	80.6		79.5
2½								82.7						
3	85.9		93.5	92.4	93.1	91.3	86.4		91.7	87.5	86.5	87.2	86.1	85.4
3½		80.3						89.1						
4	94.1		97.7	98.2	98.5	97.7	92.7		96.5	92.8	95.6	94.3	92.0	92.0
4½								96.8						
5			104.2	103.0	103.2	102.7	98.8		102.8	99.6	99.7	100.7	97.0	97.5
5½		95.3						103.3						
6			111.8	108.0	108.6	107.5	104.7		105.8	105.9		108.3	103.4	102.8

HEIGHT OF FEMALES IN CENTIMETERS

	American									
Age in Years	1a. Boas[25]	1b. Boas[26]	1c. Boas[27]	1d. Boas[28]	1e. Boas[29]	1f. Boas[30]	1g. Boas[31]	1h. Boas[32]	1i. Boas[33]	1j. Boas[34]
Birth										
½										
1½										
2										
2½										
3							96.5			
3½										
4	96.0	95.3	99.5	93.0	98.3	98.1	96.7	95.0	99.5	96.5
4½										
5	110.0	105.5	103.9	102.6	103.9	101.1	100.6	104.2	102.7	100.9
5½										
6	118.3	109.6	111.9	108.6	110.3	107.9	107.4	112.0	106.5	108.3

HEIGHT OF FEMALES IN CENTIMETERS

	American					English					Bel.	Fr.
Age in Years	1k. Boas[35]	1l Boas[36]	2. Freeman[37]	3. Hrdlička[38]	4. Peckham[39]	5. Boyd[40]	6. Roberts[41]	7a. Tuxford & Glegg[42]	7b. Tuxford & Glegg[43]	7c. Tuxford & Glegg[44]	9. Quetelet[45]	10. Variot & Chaumet[46]
Birth						44.5	49.1				49.3	
½			65.8									
1			75.5				63.1				69.1	
1½			82.6			70.4						73.6
2			86.6		75.4		82.1				78.0	
2½			92.9									81.8
3		88.5	93.9	84.0	83.7		91.6	91.6	91.9	90.9	85.3	
3½			98.2			80.3						88.4
4	96.5	76.5	104.9	90.6	92.2		96.9	98.1	99.2	96.7	91.4	
4½												95.8
5	100.1	101.3	105.3	98.5			103.7	102.6	103.1	102.0	97.3	
5½						94.0						101.9
6	108.9	107.2	117.1	109.0			108.3	107.6	108.0	107.2	103.1	

HEIGHT OF FEMALES IN CENTIMETERS

	German			Russian	Italian	Japanese
Age in Years	12. Daffner[47]	13. Ranke[48]	14. Schmid-Monnard[49]	15. Weissenberg[50]	16. Pagliani[51]	17. Misawa[52]
Birth	51.9	48.6	51.7	50.0		48.8
½						
1	77.1	61.8	70.5			72.9
1½						
2	83.3	75.6	80.0	78.5		79.0
2½						
3	89.8	85.2	86.5	87.8	84.6	84.9
3½						
4	95.8	92.0	95.6	92.3	91.4	91.0
4½						
5	100.2	97.0	99.7	99.8	96.5	96.5
5½						
6	103.8	107.3		106.6	102.1	102.4

WEIGHT OF MALES IN KILOGRAMS

	American		English					Bel.	Fren.	German	
Age in Years	2. Freeman[53]	4. Peckham[54]	5. Boyd[55]	6. Roberts[56]	7a. Tuxford & Glegg[57]	7b. Tuxford & Glegg[58]	7c. Tuxford & Glegg[59]	9. Quetelet[60]	10. Variot & Chaumet[61]	11. Camerer[62]	14. Schmid-Monnard[63]
Birth	3.6		2.3	3.2				3.1			3.4
½	7.5										
1	9.9							9.9		10.1	8.6
1½	12.4		6.5						9.5		
2	13.1	11.1		14.7				11.0		13.2	11.1
2½	15.2								11.7		
3	16.9	13.8		15.4	14.9	14.9	14.7	12.5		15.4	13.2
3½	17.2		9.1						13.0		
4	18.6	15.9		16.9	16.3	16.4	16.1	14.0		16.8	14.7
4½									14.3		
5	20.6			18.1	17.5	17.7	17.3	15.9		19.3	16.1
5½			11.6						15.9		
6	21.7			20.1	19.3	19.4	19.3	17.8		21.1	

WEIGHT OF MALES IN KILOGRAMS

	Italian	Japanese	
Age in Years	16. Pagliani[64]	17. Misawa[65]	18. Miwa[66]
Birth		3.0	
½			
1		9.0	
1½			
2		10.8	
2½			
3	12.4	12.4	14.1
3½			
4	13.5	13.7	15.0
4½			
5	15.2	15.2	16.4
5½			
6	16.7	16.5	17.2

WEIGHT OF FEMALES IN KILOGRAMS

	American		English						Danish	Belg.	French	German		Italian	Japanese	
Age in Years	2. Freeman[67]	4. Peckham[68]	5. Boyd[69]	6. Roberts[70]	7a. Tuxford and Glegg[71]	7b. Tuxford and Glegg[72]	7c. Tuxford and Glegg[73]	8. Vahl[74]	9. Quetelet[75]	10. Variot and Chaumet[76]	11. Camerer[77]	14. Schmid-Monnard[78]	16. Pagliani[79]	17. Misawa[80]	18. Miwa[81]
Birth	3.5		1.9	3.1					3.0			3.3		2.9	
½	7.2														
1	9.4								8.6		10.1	8.6		8.5	
1½	11.6		6.0							9.3					
2	13.3	10.5							11.0		12.0	11.0		9.9	
2½	14.4									11.4					
3	16.3	13.3		14.5	14.4	14.5	14.3	14.7	12.4		14.0	12.6	11.2	11.5	13.4
3½	17.0		8.4							12.5					
4	18.5	15.1		16.1	15.8	15.9	15.7	16.2	13.9		15.7	14.3	13.1	12.9	14.8
4½										13.9					
5	19.5			18.0	17.1	17.2	16.9	17.9	15.3		17.5	15.6	15.0	14.5	15.6
5½			11.1							15.2					
6	21.4			19.2	18.6	18.7	18.4	18.9	16.7		19.0		16.4	16.0	16.8

HEIGHT OF PRE-SCHOOL CHILDREN IN CENTIMETERS

	Males			Females		
	American		German	American		German
Age in Months	19. Baldwin[82]	20. Crum[83]	21. Schmid-Monnard[84]	19. Baldwin[85]	20. Crum[86]	21. Schmid-Monnard[87]
13	74.7	75.9	70.7	73.2	74.6	71.8
14	76.0	76.8	72.2	74.2	74.9	70.9
15	76.6	78.1	73.0	75.2	76.5	70.5
16	77.7	79.1	74.1	76.2	77.5	72.5
17	79.1	79.7	76.0	77.2	78.1	73.8
18	79.4	80.6	74.6	78.1	79.1	74.1
19	80.4	81.9	76.1	79.3	80.0	73.8
20	82.1	82.9	77.5	80.8	81.3	74.6
21	82.9	83.5	75.7	81.3	81.9	75.2
22	83.7	84.5	78.2	82.4	82.9	77.7
23	84.5	85.4	78.1	82.9	83.5	77.0
24	84.9	85.7	78.8	83.5	84.8	79.5
25	85.8	86.4	80.0	83.9	85.7	79.2
26	86.7	86.7	81.6	84.7	86.0	80.4
27	87.0	88.3	80.0	85.9	86.0	80.0
28	87.8	89.2	82.0	86.5	87.9	80.0
29	88.3	89.9	82.5	86.8	88.3	83.5
30	88.6	89.9	83.7	87.9	88.6	83.4
31	89.4	90.2		88.6	89.2	
32	91.2	91.4		89.7	89.9	
33	91.3	91.8		90.1	90.5	
34	91.9	92.7		90.5	92.7	
35	92.5	93.3		91.3	92.7	
36	92.8	94.3		91.5	93.3	
37	93.7	94.9		92.4	93.3	
38	94.1	95.3		92.9	94.0	
39	94.8	96.2		94.0	94.6	
40	95.5	97.8		94.2	95.3	
41	95.8	98.1		94.6	95.9	
42	96.3	98.1		95.3	96.5	
43	97.6	98.4		96.2	97.2	
44	98.0	98.7		96.4	97.8	
45	98.8	99.1		97.3	97.8	
46	99.3	99.1		97.8	98.4	
47	99.3	99.7		98.3	98.7	
48	100.1	100.3		98.4	99.1	
49	99.9			99.9		
50	100.8			99.9		

51	101.6			100.5		
52	101.7			100.9		
53	102.1			101.1		
54	102.7			101.7		
55	103.2			102.1		
56	104.0			103.0		
57	105.0			103.8		
58	105.3			104.3		
59	105.5			105.1		
60	105.8			105.1		
61	106.4			105.3		
62	106.7			106.0		
63	107.7			105.5		
64	107.0			106.4		
65	107.2			107.2		
66	108.8			107.4		
67	109.6			107.0		
68	109.8			108.3		
69	110.4			108.7		
70	111.5			110.8		
71	112.1			110.3		
72	112.0			109.7		

WEIGHT OF PRE-SCHOOL CHILDREN IN KILOGRAMS

	Males			Females		
	American		German	American		German
Age in Months	19. Baldwin[88]	20. Crum[89]	21. Schmid-Monnard[90]	19. Baldwin[91]	20. Crum[92]	21. Schmid-Monnard[93]
13	9.5	10.4	8.48	9.2	9.5	8.28
14	9.8	10.4	8.90	9.2	9.8	8.35
15	10.0	10.7	8.83	9.3	9.9	8.20
16	10.1	10.9	9.41	9.5	10.3	8.81
17	10.4	11.1	9.81	9.7	10.4	9.16
18	10.6	11.2	9.65	9.9	10.6	9.22
19	10.8	11.6	9.82	10.2	10.8	9.25
20	11.1	11.7	9.97	10.6	10.9	9.08
21	11.3	11.7	9.91	10.6	11.2	9.26
22	11.5	12.2	10.33	10.8	11.5	9.89
23	11.7	12.2	10.23	11.1	11.6	9.70
24	11.7	12.3	10.55	11.1	12.0	10.11
25	11.9	12.6	10.54	11.4	12.2	10.06
26	12.2	12.8	11.13	11.4	12.4	10.34

27	12.3	13.2	11.10	11.7	12.4	10.51
28	12.3	13.2	11.00	11.9	12.6	10.15
29	12.6	13.3	11.15	12.0	12.6	11.10
30	12.8	13.4	11.41	12.2	12.8	10.83
31	12.9	13.8		12.4	13.0	
32	13.3	13.9		12.6	13.2	
33	13.5	13.9		12.7	13.2	
34	13.4	14.1		12.8	13.7	
35	13.7	14.5		13.0	13.7	
36	13.7	14.6		13.1	13.8	
37	14.0	14.6		13.3	13.9	
38	14.0	14.7		13.5	14.1	
39	14.2	15.0		13.7	14.3	
40	14.3	15.2		13.6	14.5	
41	14.4	15.3		13.8	14.6	
42	14.6	15.3		14.1	14.7	
43	14.9	15.3		14.2	14.9	
44	15.0	15.5		14.2	15.0	
45	15.0	15.6		14.3	15.1	
46	15.4	15.8		14.5	15.2	
47	15.4	16.2		14.7	15.2	
48	15.5	16.3		14.6	15.3	
49	15.9			15.0		
50	15.6			15.1		
51	15.8			15.3		
52	15.9			15.3		
53	16.1			15.4		
54	16.3			15.4		
55	16.2			15.6		
56	16.3			15.8		
57	16.7			16.1		
58	16.9			16.0		
59	17.0			16.5		
60	16.9			16.4		
61	17.2			16.5		
62	17.3			16.9		
63	17.5			16.7		
64	17.3			16.6		
65	17.5			17.1		
66	17.7			17.1		
67	18.2			17.5		
68	18.3			17.5		
69	18.6			18.2		
70	18.9			18.3		
71	18.6			17.9		
72	18.6			18.1		

II. PRE-SCHOOL

1. Bib. 95, 1911, American born Bohemian, M 82. Continued in Section III as Column 12, height of males.
2. Bib. 95, 1911, American born Hungarian and Slovak, M 37. Continued in Section III as Column 13, height of males.
3. Bib. 95, 1911, American born Polish, M 19. Continued in Section III as Column 14, height of males.
4. Bib. 95, 1911, American born Hebrew, M 99. Continued in Section III as Column 15, height of males.
5. Bib. 95, 1911, American born Sicilian, M 111. Continued in Section III as Column 16, height of males.
6. Bib. 95, 1911, American born Neopolitan, M 137. Continued in Section III as Column 17, height of males.
7. Bib. 95, 1911, foreign born Bohemian, M 8. Continued in Section III as Column 20, height of males.
8. Bib. 95, 1911, foreign born Neopolitan, M 22. Continued in Section III as Column 25, height of males.
9. Computed from data of private cases furnished by Dr. Freeman, M 184.
10. Bib. 403, 1899, New York, negro asylum children. Continued in Section III as Column 46, height of males.
11. Bib. 581, 1882, Milwaukee, school children, M and F 228.
12. Bib. 114, 1861, London.
13. Bib. 663, 1878, all classes. Continued in Section III as Column 73, height of males.
14. Bib. 827, 1911, all England, M 119,427. Continued in Section III as Column 84, height of males.
15. Bib. 827, 1911, county education areas, M 60,550. Continued in Section II as Column 85, height of males.
16. Bib. 827, 1911, urban education areas, M 58,877. Continued in Section III as Column 86, height of males.
17. Bib. 628, 1836, M 10 at each age. Continued in Section III as Column 95, height of males.
18. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 98, height of males.
19. Bib. 190, 1884, M 426.
20. Bib. 645, 1905. Continued in Section III as Column 115, height of males.
21. Bib. 723, 1901, Halle, M 345. Continued in Section III as Column 126, height of males.
22. Bib. 865, 1911, M 239. Continued in Section III as Column 151, height of males.
23. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 153, height of males.
24. Bib. 528, 1909. Continued in Section III as Column 156, height of males.
25. Bib. 95, 1911, American born Scotch, F 5. Continued in Section III as Column 10, height of females.
26. Bib. 95, 1911, American born Bohemian, F 85. Continued in Section III as Column 11, height of females.
27. Bib. 95, 1911, American born Hungarian and Slovak, F 30. Continued in Section III as Column 12, height of females.
28. Bib. 95, 1911, American born Polish, F 29. Continued in Section III as Column 13, height of females.
29. Bib. 95, American born Hebrew, F 102. Continued in Section III as Column 14, height of females.
30. Bib. 95, 1911, American born Sicilian, F 94. Continued in Section III as Column 15, height of females.

31. Bib. 95, 1911, American born Neopolitan, F 104. Continued in Section III as Column 16, height of females.
32. Bib. 95, 1911, foreign born Bohemian, F 12. Continued in Section III as Column 19, height of females.
33. Bib. 95, 1911, foreign born Hungarian and Slovak, F 7. Continued in Section III as Column 20, height of females.
34. Bib. 95, 1911, foreign born Hebrew, F 23. Continued in Section III as Column 22, height of females.
35. Bib. 95, 1911, foreign born Sicilian, F 30. Continued in Section III as Column 23, height of females.
36. Bib. 95, 1911, foreign born Neopolitan, F 23. Continued in Section III as Column 24, height of females.
37. Computed from data of private cases furnished by Dr. Freeman, F 149, height of females.
38. Bib. 403, 1899, New York, negro asylum children. Continued in Section III as Column 39, height of females.
39. Bib. 581, 1882, Milwaukee, school children, M and F 228.
40. Bib. 114, 1861, London.
41. Bib. 663, 1878, all classes. Continued in Section III as Column 62, height of females.
42. Bib. 827, 1911, all England, F 114, 903. Continued in Section III as Column 65, height of females.
43. Bib. 827, 1911, county education areas F 58,603. Continued in Section III as Column 66, height of females.
44. Bib. 827, 1911, urban education areas, F 56,300. Continued in Section III as Column 67, height of females.
45. Bib. 628, 1836, F 10 at each age. Continued in Section III as Column 76, height of females.
46. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 77, height of females.
47. Bib. 190, 1884, F 344.
48. 645, 1905. Continued in Section III as Column 87, height of females.
49. Bib. 723, 1901, Halle, F 285. Continued in Section III as Column 92, height of females.
50. Bib. 865, 1911, F 223. Continued in Section III as Column 103, height of females.
51. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 104, height of females.
52. Bib. 528, 1909. Continued in Section III as Column 107, height of females.
53. Computed from data of private cases furnished by Dr. Freeman, M 508.
54. Bib. 581, 1882, Milwaukee, school children, M and F 228.
55. Bib. 114, 1861, London.
56. Bib. 663, 1878, all classes. Continued in Section III as Column 54, weight of males.
57. Bib. 827, 1911, all England, M 119,427. Continued in Section 111 as Column 66, weight of males.
58. Bib. 827, 1911 county education areas, M 60,550. Continued in Section III as Column 67, weight of males.
59. Bib. 827, 1911, urban education areas, M 58,877. Continued in Section III as Column 68, weight of males.
60. Bib. 628, 1836, M 10 at each age. Continued in Section III as Column 74, weight of males.
61. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 76, weight of males.
62. Bib. 375, 1911, taken from Heubner. Continued in Section III as Column 79, weight of males.

63. Bib. 723, 1901, Halle, M 345. Continued in Section III as Column 98, weight of males.
64. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 122, weight of males.
65. Bib. 528, 1909. Continued in Section III as Column 127, weight of males.
66. Bib. 529, 1893. Continued in Section III as Column 129, weight of males.
67. Computed from data of private cases furnished by Dr. Freeman, F 393.
68. Bib. 581, 1882, M and F 228.
69. Bib. 114, 1861, London.
70. Bib. 663, 1878, all classes. Continued in Section III as Column 38, weight of females.
71. Bib. 827, 1911, all England, F 138,253. Continued in Section III as Column 40, weight of females.
72. Bib. 827, 1911, county education areas, F 10,101. Continued in Section III as Column 41, weight of females.
73. Bib. 827, 1911, urban education areas, F 56,300. Continued in Section III as Column 42, weight of females.
74. Bib. 832, 1884. Continued in Section III as Column 48, weight of females.
75. Bib. 628, 1836 F 10 at each age. Continued in Section III as Column 49, weight of females.
76. Bib. 838, 1906, Paris, poorer class. Continued in Section III as Column 50, weight of females.
77. Bib. 375, 1911, taken from Heubner. Continued in Section III as Column 53, weight of females.
78. Bib. 723, 1901, Halle, F 285. Continued in Section III as Column 61, weight of females.
79. Bib. 573 and 574, 1875-79, Turin. Continued in Section III as Column 74, weight of females.
80. Bib. 528, 1909.
81. Bib. 529, 1893.
82. 1920, Iowa, M 18,770. See page 65.
83. Bib. 185, about 1915, M 5602.
84. Bib. 718, 1892, M 823.
85. 1920, Iowa, F 18,188. See page 65.
86. Bib. 185, about 1915. F 4281.
87. Bib. 718, 1891-92, F 736.
88. 1920, Iowa, M 18,770. See page 65.
89. Bib. 185, about 1915, M 5602.
90. Bib. 718, 1891-92, M 823.
91. 1920, Iowa, F 18,188. See page 65.
92. Bib. 185, about 1915, F 4821.
93. Bib. 718, 1891-92, F 736.

III. SCHOOL CHILDREN AND ADULTS
HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	1b. Baldwin[1]	1a. Baldwin[2]	2a. Baldwin[3]	2b. Baldwin[4]	3. Barnes[5]	4. Beyer[6]	5a. Boas[7]	6. Boas[8]	5b. Boas[9]	7. Boas[10]	8a. Boas[11]
5		102.2	110.8						105.9	104.8	112.0
5½		109.2	111.7								
6	116.1	115.3	115.3		112.0		111.9	113.7	111.6		112.7
6½	119.1	118.5	118.4								
7	120.7	121.8	121.3	122.7	114.3		117.9	118.0	116.8	108.9	127.0
7½	125.0	122.7	122.7	125.5							
8	127.8	125.7	126.8	127.8	120.9		122.8	124.8	122.1	118.2	122.2
8½	130.8	125.9	128.2	129.2							
9	131.1	130.5	131.0	132.3	125.2		127.8	128.3	126.9	127.0	126.0
9½	133.9	132.6	134.2	135.0							
10	135.9	136.3	136.1	136.4	131.8		132.9	133.4	131.8		135.7
10½	138.9	139.1	139.1	138.8							
11	138.9	140.6	140.6	141.9	135.9		137.4	137.9	136.2	144.8	141.0
11½	142.0	144.0	144.0	144.2							
12	145.0	145.2	144.2	146.2	140.0		142.6	142.6	140.7		145.0
12½	147.1	146.7	148.7	148.9							
13	149.9	147.9	150.5	151.7	144.3		147.9	148.2	146.0		143.0
13½	151.9	151.1	155.1	154.7							
14	154.7	155.0	156.7	157.8	151.6		154.6	155.6	152.4	146.6	156.9
14½	159.0	157.9	160.3	162.1							
15	163.8	161.8	162.4	166.6	157.0	162.1	162.0	163.2	159.7		162.6
15½	164.3	165.4	167.5	168.1							
16	166.9	166.8	169.6	169.7	163.8	167.5	166.0	166.8	164.9		159.7
16½	166.4	171.1	172.6	172.2							
17	168.9	171.4	169.9	173.9	170.4	170.3	168.6		168.9		171.8
17½	168.9	171.3	175.2	173.2							
18	168.9	171.4	173.8	176.8	171.7	170.9			171.1	165.4	167.8
18½			173.9	178.1							
19						172.5				177.0	172.0
20						174.0				174.7	169.5
21						174.2					172.0
22						173.9					175.2
23						174.3				177.4	175.0
24											175.7
25										165.0	
27										163.6	
28										160.4	
30										158.1	
34										160.2	
35										161.8	
40										170.0	
										**	**

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	8b. Boas[12]	8c. Boas[13]	8d. Boas[14]	8e. Boas[15]	8f. Boas[16]	8g. Boas[17]	8h. Boas[18]	8i. Boas[19]	8j. Boas[20]	8k. Boas[21]	8l. Boas[22]
5	105.7	104.6	106.4	104.2	102.7	101.8			101.0	101.0	99.0
5½											
6	110.7	109.6	107.8	108.7	108.9	107.3		108.2	110.6	111.5	108.7
6½											
7	116.0	115.6	114.5	114.6	113.1	112.9	119.5	111.0	111.7	115.9	108.5
7½											
8	122.5	120.6	119.3	122.3	119.2	116.2	122.2	124.0	118.2	119.0	118.3
8½											
9	128.5	126.6	126.5	127.0	125.2	124.2	125.0		128.1	124.0	130.0
9½											
10	132.7	130.7	139.5	131.6	129.4	129.2	129.4	129.7	135.1	131.5	127.7
10½											
11	137.7	138.4	137.0	135.9	134.5	134.3	133.6	143.0	134.7	134.7	138.0
11½											
12	141.1	142.1	135.3	140.6	138.4	136.4	136.4		140.0	139.2	145.2
12½											
13	147.9	144.7	143.0	145.8	142.7	142.2	141.6	150.5	148.1	145.1	
13½											
14	152.3	147.7	153.3	152.4	147.0	147.3	148.3		150.4	150.3	155.5
14½											
15	155.5	153.7	151.0	155.3	153.1	149.9	155.8	161.0	155.2	151.7	148.0
15½											
16	162.7	158.0	173.0	159.8	159.0	158.4	126.0		160.7	163.5	170.0
16½											
17	167.6			164.1	159.5	160.2	164.0	171.0	165.0	171.0	
17½											
18	175.0	173.0	165.0	168.8	169.5	169.0	162.0	168.0	167.7	162.5	180.0
18½											
19	171.2			167.8		154.5		167.7	167.0	163.5	160.7
19½											
20	168.6				163.0		160.0	170.0	171.0	168.5	160.8
20½											
21	171.7							166.0	167.6	169.5	171.5
22	171.0							168.2	165.4	167.0	169.5
23	169.0							171.1	159.5	163.5	167.3
24	171.3							171.5	161.0	165.3	166.3
25	174.5							174.3	170.1	162.0	169.5
26											
27											
28			166.0								
	**	**		**				**	**	**	**

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	8m. Boas[23]	8n. Boas[24]	8o. Boas[25]	8p. Boas[26]	9. Bowditch[27]	10. Bowditch[28]	11a. Bowditch[29]	11b. Bowditch[30]	12. Cordeiro[31]	13. Gilbert[32]	14. Gilbert[33]
5	101.2	103.0	103.7		105.6						
5½											
6	106.0	108.6	109.5		111.1					114.3	114.3
6½											
7	114.1	114.1	114.3		116.2					119.6	121.4
7½											
8	120.9	120.2	119.1		121.3					124.2	126.0
8½							121.2	122.2			
9	125.5	126.3	122.9	132.0	126.2	132.1				130.2	130.3
9½							126.4	127.1			
10	129.4	130.2	127.4		131.3	135.9				134.6	135.4
10½							131.0	132.5			
11	135.6	132.9	132.9		135.5	139.6				142.0	140.2
11½							135.1	136.8			
12	138.1	138.4	136.7	136.3	140.0	144.2				144.8	145.0
12½							139.5	142.1			
13	143.9	142.7	140.7	139.2	145.3	151.4			149.9	149.4	149.1
13½							144.5	147.7			
14	150.5	148.0	147.8	150.6	152.1	156.2			155.2	150.5	156.7
14½							150.7	153.8			
15	154.7	152.7	151.2	164.0	158.4	163.1			161.2	159.5	164.3
15½											
16	159.0	159.5	155.6	163.0	165.1	167.2			165.0	166.9	169.4
16½											
17	162.9	165.0	161.7		168.1	171.3				170.4	173.2
17½											
18	163.7	163.1	165.8		169.3	171.3					174.2
18½											
19	165.0	164.8	165.3								175.3
19½											
20		165.7	162.3	163.5							
20½											
21		167.1	162.5								
22		164.9	165.5								
23		167.7	167.7								
24		166.4	163.4								
25		163.7	163.0								
26	**	**	**								
27											
28											
29											
30											
31											

HEIGHT OF MALES IN CENTIMETERS

	American										
Age in Years	15a. Greenwood[34]	15b. Greenwood[35]	16b. Greenwood[36]	16a. Greenwood[37]	16c. Greenwood[38]	17. Hall[39]	19a. Hastings[40]	19b. Hastings[41]	21. Hastings[42]	20. Hastings[43]	22. Hitchcock[44]
5									105.7	105.6	
5½											
6									110.6	110.5	
6½											
7									115.7	115.5	
7½											
8									121.3	121.1	
8½											
9						130.1			125.9	125.6	
9½											
10						136.9			130.9	130.7	
10½											
11	132.8	127.5	129.5		132.1	140.0			134.9	134.7	
11½											
12	135.4	128.5	135.5	137.1	134.6	144.0			140.3	140.0	
12½											
13	140.7	137.2	136.5	139.1	142.2	154.9			145.0	143.8	
13½											
14	145.5	141.5	142.2	148.8	143.8	158.2			151.0	150.8	
14½											
15	148.6	146.8	149.6	150.0	148.8	165.9			158.1	157.9	
15½											
16	159.5	157.7	154.9	158.5	158.5	168.9			163.7	163.4	171.2
16½											
17			163.7		162.3	170.4	168.1	169.2		169.7	172.5
17½											
18			165.1		164.6	170.9	169.1	170.1		170.8	173.2
18½											
19					169.3	171.5	167.8	170.9		171.5	173.2
19½											
20						171.7	172.2	172.6		171.9	173.0
20½											
21						172.0	172.0	172.8			173.0
22							173.1	173.0			173.2
23							173.4	173.5			173.0
24							174.5	173.8			173.2
25							174.8	174.5			173.2
26							173.8	174.8			175.0
27							173.5	173.5			
28							174.4	174.0			
29							172.9	173.0			
30							175.7	175.7			
31											

HEIGHT OF MALES IN CENTIMETERS

Age in Years	American										
	23a. Hrdlička[45]	23b. Hrdlička[46]	23c. Hrdlička[47]	24a. Macdonald[48]	24b. Macdonald[49]	24c. Macdonald[50]	25. Peckham[51]	26b. Peckham[52]	27. Porter[53]	28. Porter[54]	29. Robertson[55]
5		104.4	96.1				107.4				
5½											
6	102.5	110.1	105.1	113.0	112.1	114.3	112.0		109.0	108.9	117.1
6½											
7	111.3	114.6	112.0	116.8	116.4	116.9	117.1		114.1	114.0	121.7
7½											
8	113.3	119.6	115.2	121.4	121.1	121.7	122.1		119.1	119.1	127.8
8½											
9	119.7	125.1	121.2	126.2	125.8	126.8	127.0		124.5	124.4	132.6
9½											
10	123.4	127.1	124.8	131.3	130.1	132.1	131.7		128.8	128.9	135.9
10½											
11	128.7	136.0	131.5	135.1	133.9	135.9	136.6		133.9	133.9	142.2
11½											
12	133.7	138.1	136.2	140.0	139.3	140.6	139.7		138.2	138.2	151.6
12½											
13	136.8	139.2	142.0	144.3	143.2	144.5	146.1		143.0	142.9	151.4
13½											
14	122.5	150.4	144.9	150.1	149.0	151.6	152.2		148.1	148.6	156.7
14½											
15	135.7	145.5	146.2	157.0	157.2	165.2	158.2	160.9	154.9	154.9	
15½											
16		150.0	161.8	163.3	160.2	170.1	165.4	165.4	160.3	160.3	
16½											
17			155.4	167.6	167.2		169.2	167.7	165.1	165.1	
17½											
18				170.4				172.4		170.4	
18½											
19								173.0			
19½											
20								174.1			
20½											
21								174.7			
22								174.4			
23								175.2			
24								176.0			
25								177.1			
26											
27											
28											
29											

HEIGHT OF MALES IN CENTIMETERS

	American								
Age in Years	30. Smedley[56]	31. Sternberg[57]	32a. Sternberg[58]	32b. Sternberg[59]	32c. Sternberg[60]	33b. Stiles & Wheeler[62]	33a. Stiles & Wheeler[61]	34. West[63]	35. Young[64]
5								109.7	
6	110.7					112.6	112.3	112.8	117.0
6½	113.3								
7	115.8					119.5	119.5	117.1	125.0
7½	118.4								
8	120.9					123.2	122.9	122.3	132.0
8½	123.5								
9	126.1					127.4	127.6	127.0	135.3
9½	128.8								
10	130.9					132.6	132.8	134.0	137.1
10½	133.1								
11	135.1					136.4	136.5	138.8	141.7
11½	137.2								
12	139.6					142.2	141.8	142.9	149.0
12½	141.9								
13	145.5					148.1	147.6	147.6	155.0
13½	149.1								
14	151.9					151.9	151.5	154.3	157.2
14½	154.8								
15	158.1					159.1	159.5	162.3	
15½	161.4								
16	164.1	162.8			164.0			165.9	
16½	166.7					168.8	169.2		
17	167.9	166.8			168.8			168.4	
17½	169.1		169.3						
18	171.3	168.6		167.9	171.3			169.9	
18½	173.4		171.5						
19		170.4		169.3	171.2			171.2	
19½			169.3						
20		171.5		171.9	173.0			174.0	
20½			170.6						
21		172.2	170.8	170.8	170.7			170.4	
22		172.5	170.3	170.6	171.9				
23		172.8	171.5	171.1	172.1				
24		172.8	170.0	170.6	171.6				
25		172.9	171.3	171.4	171.6				
26		173.0	170.3	171.3	171.8				
27		173.0	171.2	171.3	171.3				
28		173.1	170.9	170.5	171.6				
29		173.2	170.7	171.5	172.2				
30		173.2	170.7	168.2	172.1				
		**	**	**	**				

HEIGHT OF MALES IN CENTIMETERS

	Canadian	Amer. and Engl.	English								
Age in Years	36. Boas[65]	37. Stephenson[66]	39a. Elderton[67]	39b. Elderton[68]	40. Galton[69]	41. Galton[70]	42. Kerr[71]	43. Maclaren[72]	44a. Roberts[73]	44b. Roberts[74]	44c. Roberts[75]
5	106.3	104.9			97.8	104.1			104.2	104.8	104.6
5½											
6	111.0	111.5	104.9	109.2	104.1	111.8	121.0		111.8	109.1	109.7
6½											
7	116.2	116.5	109.2	113.8	111.8	116.8	126.0		116.8	114.9	114.3
7½											
8	121.4	120.4	114.6	119.1	116.8	119.4	131.5		119.5	119.3	119.4
9	126.2	126.2	119.4	124.5	119.6	126.2	137.0		126.2	124.3	125.1
10	131.2	131.5	124.0	129.3	126.2	131.6	142.0	135.9	131.7	127.8	128.4
11	135.5	135.8	128.5	133.6	131.6	135.9	148.0	139.7	135.9	130.1	130.9
12	139.9	139.8	132.8	137.7	135.9	139.7	155.0	144.2	139.7	133.4	134.7
13	145.5	144.9	136.7	142.0	139.7	144.8	161.0	148.6	144.6	138.8	142.2
14	150.6	151.4	140.2	146.6	144.5	150.6	166.0	154.3	150.7	142.4	146.7
15		158.2			150.6	158.0	170.0	160.0	158.1	150.1	153.9
15½									163.4		
16		164.2			158.0	163.3	172.5	165.1		162.3	159.8
16½									168.3		
17		168.2			163.3	168.2	174.0	170.2		167.4	163.7
17½									170.1		
18		169.7			168.2	169.9		172.7		169.6	166.3
18½									170.9		
19					170.2	170.9				170.7	167.7
19½									171.5		
20					170.9	171.5				170.8	168.4
20½									171.8		
21					171.5	171.7			171.9	171.5	
22					171.7				171.4	171.8	169.2
23									172.0		
24									172.1		
25									172.2		
26									172.5		169.4
27									172.0	172.5	
28									172.4		
33									172.4		
36										170.7	
38									173.0		
39									**		

HEIGHT OF MALES IN CENTIMETERS

Age in Years	English										
	44d. Roberts[76]	44h. Roberts[77]	44i. Roberts[78]	45. Shuttleworth[79]	46. Stanway[80]	47a. Stephenson[81]	47b. Stephenson[82]	48. Thorne[83]	49a. Tuxford & Glegg[84]	49b. Tuxford & Glegg[85]	49c. Tuxford & Glegg[86]
5				104.1					103.0	103.2	102.7
5½											
6				109.2					108.0	108.6	107.5
6½											
7		117.3		114.3					114.7	115.3	114.3
7½											
8		120.2		119.4					119.3	119.5	119.0
8½											
9		127.5	130.8	124.5				128.3	124.7	126.6	123.7
9½											
10	135.6	133.9	135.4	129.5	128.3	128.3	134.6	139.1	129.4	130.0	129.1
10½											
11	139.4	136.8	143.3	134.6	130.3	130.8	138.4	143.5	134.2	135.2	133.7
11½											
12	144.6	141.0	146.6	139.7	135.1	135.9	143.5	144.2	139.8	140.2	138.9
12½											
13	149.3	148.1	152.2	146.1	139.2	141.0	148.6	152.4	142.5	142.6	142.4
13½											
14	155.2	152.0	157.7	152.4	144.0	147.3	154.9	158.8	147.1	147.8	146.8
14½											
15	161.2	159.0	163.1	157.5	150.1	153.7	161.3	165.1			
15½	168.7										
16		165.4	167.9	162.6	158.0	160.0	168.9	168.3			
16½	172.4										
17		169.5	170.7	166.4	162.1	163.8	172.7				
17½	173.5										
18		172.7		168.9		166.4	174.0				
18½	174.6										
19		175.7		170.2		167.6	174.5				
19½	175.6										
20				170.8		168.2	175.3				
20½	175.7										
21	177.6					168.9	175.3				
22	174.0										
23	175.1										
27	175.4			171.5							
30						168.9	175.3				

HEIGHT OF MALES IN CENTIMETERS

	Norwegian				Swedish		Danish		Belgian		Fren.
Age in Years	50 Schiötz[87]	51a Schiötz[88]	51b Schiötz[89]	51c Schiötz[90]	52a Key[91]	52b Key[92]	53a Hertel[93]	53b Hertel[94]	55 Quetelet[95]	56 Zeising[96]	57 Godin[97]
5									98.8		
5½											
6		116.0			116.0		112.0		104.7		
6½											
7		119.1	124.1	120.1	121.0		115.1		110.5		
7½											
8		122.9	128.2	126.2	126.0		119.9		116.2	125.4	
8½						122.0					
9		127.6	135.0	127.7	131.0		125.0		121.8	126.0	
9½						125.0					
10		132.7	140.2	132.8	133.0		130.1		127.3	130.5	
10½						129.0					
11		136.5	142.7	136.7	136.0		134.9		132.5	132.3	
11½						134.0		141.0			
12	144.0	140.4	147.5	141.8	140.0		137.9		137.5	136.0	
12½						137.0		143.0			
13	148.7	145.2	152.3	148.5	144.0		143.0		142.3	140.0	
13½						142.0		146.0			145.2
14	154.2	150.0	161.1	151.2	149.0		149.1		146.9	143.0	146.6
14½						144.0		151.0			149.8
15	163.6				156.0		156.0		151.4		153.6
15½						152.0					155.5
16	167.0				162.0		164.1		155.5		158.1
16½											160.1
17	170.6				167.0		166.9		159.5		161.9
17½											163.6
18					170.0		169.9		163.1		
18½											
19					171.0		169.9		165.6		
19½											
20					172.0				166.9		
20½											
21											
22											
23											
24											
25									168.2		
26											
27											
30									168.7		
40									168.7		

HEIGHT OF MALES IN CENTIMETERS

	Fr.	German									
Age in Years	58 Variot & Chaumet[98]	59a Ascher[99]	59b Ascher[100]	61 Carstädt[101]	62 Daffner[102]	63 Daffner[103]	64 Geissler[104]	65a Geissler and Uhlitzsch[105]	65b Geissler and Uhlitzsch[106]	66b Hasse[107]	66a Hasse[108]
5											
5½	103.3										
6				109.3							
6½	109.9	110.0	110.0	111.8			110.2	110.4	108.1		
7				113.8							
7½	114.4	118.0	115.0	116.8			114.4	113.8	111.4		
8				118.9							
8½	119.7	122.0	120.0	121.6			119.4	119.7	117.4	118.6	120.5
9				123.7							
9½	125.0	131.0	126.0	126.0			123.9	125.0	119.9	122.9	126.0
10				128.5							
10½	130.3	131.0	129.0	130.8			129.1	128.3	125.6	128.0	130.9
11				133.3							
11½	133.6	133.0	135.0	135.6			132.4	132.3	130.0	131.7	134.2
12				138.1							
12½	137.6	145.0	139.0	140.4			138.2	137.6	134.8	137.8	139.2
13				143.3	147.7						
13½	145.1	142.0	143.0	145.8			140.7	143.0	138.3	140.5	141.2
14				149.1	148.9						
14½	153.8			152.3						144.3	148.3
15				156.6	163.2						
15½	159.6			159.9							
16				162.8	162.5	162.6					
16½											
17					167.6	164.1					
17½											
18					171.4	166.9					
18½											
19					172.3	168.9					
19½											
20					173.7	170.4					
21					167.7	172.0					
22					176.0	173.5					
23						175.5					
24						175.5					
25						180.1					
26						182.1					

HEIGHT OF MALES IN CENTIMETERS

	German										
Age in Years	67 Kotelmann[109]	68 Landsberger[110]	69a Peiper[111]	69b Peiper[112]	69c Peiper[113]	70 Radosavljevich[114]	71 Ranke[115]	72 Reuter[116]	73a Rietz[117]	73b Rietz[118]	74 Samosch[119]
5							99.6				
5½											
6		106.9				112.4	105.9	112.0	118.1	113.4	109.0
6½			112.1	112.8	112.1						
7		112.3				117.2	111.7	115.0	121.8	117.0	115.0
7½			117.0	116.8	117.0						
8		117.3				122.1	116.9	121.0	127.3	121.4	119.0
8½			121.8	121.2	122.1						
9	128.5	122.1				127.1	121.5	127.0	131.2	126.5	125.0
9½			126.6	126.0	126.8						
10	130.7	125.4				132.0	127.2	131.0	135.7	130.9	129.0
10½			131.4	131.2	131.4						
11	135.0	130.0				135.1	130.8	133.0	139.5	135.3	133.0
11½			135.9	135.4	136.2						
12	139.9	135.2				140.4	135.4	138.0	145.4	139.7	137.0
12½			140.5	141.0	140.3						
13	143.0	139.3				147.6	139.7	142.0	150.6	144.7	142.0
13½			145.5	145.5	145.6						
14	148.8					152.2	145.3	149.0	156.0	146.6	151.0
14½											
15	154.2					160.2	149.6		162.4		
15½											
16	161.8					164.2			165.5		
16½											
17	166.9					167.1			168.7		
17½											
18	168.4					172.0			170.7		
18½											
19	166.9					173.4			170.3		
19½											
20	167.1					174.0					
20½											
21	170.0										
22	176.5										
23											
24											
25											
26											

HEIGHT OF MALES IN CENTIMETERS

	German										
Age in Years	75a Schlesinger[120]	75b Schlesinger[121]	75c Schlesinger[122]	75d Schlesinger[123]	75e Schlesinger[124]	75f Schlesinger[125]	76 Schmid-Monnard[126]	77a Schmidt[127]	77b Schmidt[128]	77c Schmidt[129]	78 Thoma[130]
5							99.7				
5½											
6	115.0	110.5	105.5	121.0	115.5	110.0	110.0				
6½								109.3			
7	121.0	113.0		124.5	118.0	115.5	115.9				
7½								114.3			
8	127.0	117.0	114.0	129.0	122.0	120.0	119.5				
8½								119.8	121.0	118.4	121.8
9	130.5	124.5	110.5	135.5	128.5	126.0	123.8				
9½								124.9	125.6	123.9	124.6
10	134.5	126.5	109.0	138.0	131.5	126.5	127.8				
10½								128.2	129.6	126.7	128.9
11	141.0	131.5	118.0	142.5	134.0	127.0	132.9				
11½								132.9	134.0	131.5	134.1
12	145.5	137.0	121.5	148.0	140.0	132.0	137.8				
12½								137.8	138.5	136.9	138.9
13	152.5	142.5	137.0	153.5	145.0	139.0	142.0				
13½								142.2	143.4	140.7	142.3
14	158.5	147.0	141.0	160.5	150.0	145.0	147.3				
14½											159.7
15	162.5	153.5	145.0	168.5	157.5	152.5					
15½											163.3
16	166.5	156.5	147.0	170.0	166.0						
16½											166.0
17				172.0	167.0						
17½											166.6
18				173.0	170.5						
18½											167.5
19				173.5	172.0	166.0					
19½											
20				174.0	166.0						
20½											
21							**				
22											
23											
24											
25											
26											

HEIGHT OF MALES IN CENTIMETERS

	Pol.	Swiss				Russian					
Age in Years	79 Suligowski[131]	80 Combe[132]	81 Ernst[133]	83a Niceforo[134]	83b Niceforo[135]	84 Dementiew[136]	86a Erismann[137]	86b Erismann[138]	87a Kosmowski[139]	88 Makower[140]	89c Michailoff[141]
5											
5½											
6											
6½											
7		117.4					112.0				
7½									116.4		
8		122.4					117.9	120.1		123.2	
8½			126.1						117.3		120.5
9	126.0	127.0					122.7	122.4		126.3	
9½			126.1						121.6		124.2
10	129.8	131.3		128.9	134.2	125.1	130.8	126.3		130.3	
10½			131.2						126.7		128.6
11	133.9	135.4		134.2	135.2	129.0	135.6	129.9		134.6	
11½			134.5						130.9		131.9
12	137.4	139.7		138.8	140.5	133.7	140.2	134.4		139.9	
12½			138.8						135.8		135.6
13	143.5	144.5		140.5	144.4	137.1	145.3	137.7		146.9	
13½			143.7						138.5		140.5
14	149.1			146.2	150.1	141.3	150.1	141.2		151.3	
14½			145.3						150.0		145.5
15	156.2					147.2	156.5	146.7		157.7	
15½											
16	161.3					152.7	161.3	153.2		161.3	
16½											
17	165.6					158.3	164.1	158.6		162.3	
17½											
18	166.4					162.4		161.8		162.9	
18½											
19	165.9					163.8		163.6		162.7	
19½											
20	168.7					164.2		164.4		163.4	
21	166.9							164.4		164.1	
22								164.6			
23								165.2			
24								165.0			
25								165.1			
26								164.9			
27								165.3			
28								165.0			
29								165.4			
30								**			

HEIGHT OF MALES IN CENTIMETERS

Age in Years	Russian										
	89a Michailoff[142]	89b Michailoff[143]	91 Sack[144]	92a Spielrein[145]	92b Spielrein[146]	93 Starkow[147]	94a Weissenberg[148]	94b Weissenberg[149]	94c Weissenberg[150]	94d Weissenberg[151]	95 Wiazemsky[152]
5										100.7	
5½											
6					113.1					108.3	
6½											
7				118.0	116.9					112.7	
7½											
8				123.9	121.1					116.7	
8½	117.7	117.8	124.8								
9				127.1	123.3					122.0	
9½	121.0	122.8	130.3								132.0
10				132.2	129.0		124.2	124.7	126.5	125.4	
10½	126.6	130.9	133.8								133.4
11				135.1	136.0	133.6	125.8	128.9	131.4	130.1	
11½	129.6	135.6	138.0								138.2
12				137.3	139.0	137.0	130.8	135.7	137.8	136.2	
12½	133.9	140.1	142.5								143.4
13				143.6	145.5	142.3	133.3	137.7	140.4	139.6	
13½	137.9	145.4	147.8								148.6
14				149.0	147.8	148.3				145.3	
14½	140.9	150.2	155.6								157.7
15					152.5	154.0				149.1	
15½	144.5	156.4	161.4								160.8
16						160.7				157.1	
16½		161.4	165.7								164.0
17						165.3				161.3	
17½		164.0	168.1								166.4
18						167.8				161.9	
18½			169.4								167.9
19						168.5				163.5	
19½			170.2								168.7
20						169.2				164.1	
20½			169.7								
21										**	
22											
23											
24											
25											
26											
27											

HEIGHT OF MALES IN CENTIMETERS

	Italian			Japanese			Chinese				Phil.
Age in Years	96a Pagliani[153]	96c Pagliani[154]	96b Pagliani[155]	99a Misawa[156]	98 Misawa[157]	99b Misawa[158]	101 Bobbitt[159]	102 Merrins[160]	103b Whyte[161]	103a Whyte[162]	104 Bobbitt[163]
5	97.0			97.5							
5½											
6	103.4			102.8							109.5
6½											
7	112.5			108.3	106.5						113.5
7½											
8	118.4			113.8	111.0						117.0
8½		115.0	122.0								
9	124.0			118.3	115.6		123.7				121.0
9½		120.0	125.4								
10	126.5			122.7	120.0		127.5				124.7
10½		125.6	128.5								
11	129.3			127.0	124.8		128.6	127.0		131.3	129.9
11½		128.5	133.6								
12	133.6			130.7	128.7		129.1	138.9	137.5	134.0	136.0
12½		132.0	137.0								
13	139.7			135.2	133.4	147.0	136.4	141.0	146.5	136.4	140.3
13½		138.6	142.5								
14	145.3			141.5	137.6	152.2	144.2	149.4	151.7	145.1	147.1
14½		140.0	150.6								
15	151.9			146.3	142.1	156.7	158.5	157.5	155.5	142.8	154.2
15½											
16	158.0				146.1	159.0		162.1	160.0	152.5	158.2
16½											
17	160.0					160.0		163.1	161.0	156.4	160.5
17½											
18	160.8							162.6	163.4	158.4	160.9
18½											
19	161.8							164.3	164.5	162.3	162.0
19½											
20								163.8			162.2
20½											
21								167.1			161.0
22								167.6			
23									**	**	
24											
25											

III. SCHOOL CHILDREN AND ADULTS. HEIGHT OF MALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. Well-to-do class, M 501, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School. Well-to-do class, M 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, M 60, consecutive measurements. Includes data of final norms page 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, M 35, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland M and F 4956.
6. Bib. 63, 1895, naval cadets.
7. Bib. 88, 1897, American, M 2386.
8. Bib. 88, 1897, Oakland, M 2053.
9. Bib. 88, 1897, American, M 45,151.
10. Bib. 80, 1891, half bloods and Indians, North Pacific coast.
11. Bib. 95, 1911, American born Scotch, M 84.
12. Bib. 95, 1911, American born Bohemian, M 915.
13. Bib. 95, 1911, American born Hungarian and Slovak, M 145.
14. Bib. 95, 1911, American born Polish, M 61.
15. Bib. 95, 1911, American born Hebrew, M 2339.
16. Bib. 95, 1911, American born Sicilian, M 420.
17. Bib. 95, 1911, American born Neopolitan, M 774.
18. Bib. 95, 1911, American born Italian, M 189.
19. Bib. 95, 1911, foreign born Scotch, M 63.
20. Bib. 95, 1911, foreign born Bohemian, M 155.
21. Bib. 95, 1911, foreign born Hungarian and Slovak, M 122.
22. Bib. 95, foreign born Polish, M 66.
23. Bib. 95, 1911, foreign born Hebrew, M 939.
24. Bib. 95, 1911, foreign born Sicilian, M 525.
25. Bib. 95, 1911, foreign born Neopolitan, M 437.
26. Bib. 95, 1911, foreign born Italian, M 50.
27. Bib. 109, 1875, Boston, M 13,695.
28. Bib. 110, 1879, foreign descent.
29. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
30. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
31. Bib. 177, 1887, U. S. navy, M 5401.
32. Bib. 294, 1895, New Haven, M 602.
33. Bib. 295, 1897, Iowa, M 50.
34. Bib. 317, 1890, American whites, M and F 724.
35. Bib. 317, 1890, negroes, M and F 223.
36. Bib. 317, 1890, negroes, M and F 574.
37. Bib. 317, foreign, M and F 385.
38. Bib. 317, 1890, Kansas City white, M and F 2619.
39. Bib. 341, 1895, Pennsylvania, M 2434.
40. Bib. 356, 1902, Amherst College, M 1321.
41. Bib. 356, 1902, Amherst College, M 2106.
42. Bib. 356, 1902, American, M 5476.
43. Bib. 356, 1902, Nebraska, M 7700.
44. Bib. 390, 1900, Amherst College, M 4880.
45. Bib. 403, 1899, Italian.
46. Bib. 403, 1899, New York, negro asylum children.
47. Bib. 403, 1899, New York, white asylum children.
48. Bib. 490, 1897-1898, Washington, D. C., M 7953.
49. Bib. 490, 1897-98, Washington, D. C., laboring class. Taken from Ernst, Bib. 241.

50. Bib. 490, 1879-98, Washington D. C., non-laboring class. Taken from Ernst, Bib. 241.
51. Bib. 580, 1881, Milwaukee, M 4773.
52. Bib. 580, 1881, Beloit College, M 533.
53. Bib. 614, 1893, St. Louis, M 16,295.
54. Bib. 615, 1894,St. Louis, M 15,525.
55. Bib. 669a, 1916, Oakland.
56. Bib. 764, 1900, Chicago, M 2788.
57. Bib. 779, 1893, American born whites fit for army, M 190,621.
58. Bib. 779, 1893, foreign born white, U. S. army, M 2388.
59. Bib. 779, 1893, negroes, U. S. army.
60. Bib. 779, 1893, native white accepted recruits, M 4547.
61. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, M 771.
62. Bib. 782, 1915, southern states, homes of good sanitary condition, M 593.
63. Bib. 873, 1896, Worcester, M and F 3250.
64. Bib. 900, 1913, Chicago, favored class, M 201.
65. Bib. 95, 1911, Toronto.
66. Bib. 778, 1888.
67. Bib. 229, 1914, Glasgow, poorer class.
68. Bib. 229, 1914, Glasgow, better class.
69. Bib. 281, 1883, schools, military and naval colleges, M and F 29,405.
70. Bib. 281, 1883, all classes.
71. Bib. 427, 1918.
72. Bib. 495, 1895.
73. Bib. 663, 1878, all classes, M and F 30,000.
74. Bib. 663, 1878, soldiers, police etc., M 29,525.
75. Bib. 663, 1878, artisan class, M 13,931.
76. Bib. 663, 1878, favored class, M 7709.
77. Bib. 663, 1878, towns, M 2613.
78. Bib. 663, 1878, Friends' school, M 4661.
79. Bib. 752, 1884, general population.
80. Bib. 773, 1833, Manchester.
81. Bib. 778, 1888, laboring class.
82. Bib. 778, 1888, non-laboring class.
83. Bib. 819, 1904, London, scholarship boys, M 1710.
84. Bib. 827, 1911, all England, M 261,531.
85. Bib. 827, 1911, county education areas, M 120,237.
86. Bib. 827, 1911, urban education areas, M 141,294.
87. Bib. 706, 1919, M 231.
88. Bib. 704, 1917, M 4463.
89. Bib. 704, 1917, Kristiania, better class, M 519.
90. Bib. 704, 1917, Kristiania Volksschule, better class, M 359.
91. Bib. 431, 1889, M 15,000.
92. Bib. 431, 1889, Volksschulen, M 15,000. Taken from Ernst, Bib. 241.
93. Bib. 368, 1882, M 17,134.
94. Bib. 368, 1882, höhere Schulen.
95. Bib. 628, 1836, M 10 at each age.
96. Bib. 905, 1854.
97. Bib. 299, 1903.
98. Bib. 838, 1906, Paris, poorer class.
99. Bib. 18, 1912, Hamm.
100. Bib. 18, 1912, Königsberg.
101. Bib. 160, 1888, Breslau, höhere Bürgerschule, M 600.
102. Bib. 191, 1884, M 700.
103. Bib. 190, 1884.
104. Bib. 291 & 292, 1888, Gohlis-Leipzig Bürgerschule, M 1386.
105. Bib. 291 & 292, 1888, Freiberg Bürgerschule, M 10,343.

106. Bib. 291 & 292, 1888, Freiberg mountaineers' children, Volksschulen.
107. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 2. Taken from Ernst, Bib. 241.
108. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
109. Bib. 449, 1879, Hamburg, Gelehrtenschulen, M 515.
110. Bib. 457, 1888, Posen, M 37.
111. Bib. 583, 1912, Pommerania Volksschulen, city and country combined, M 42,528.
112. Bib. 583, 1912, Pommerania Volksschulen, city children, M 14,914.
113. Bib. 583, 1912, Pommerania Volksschulen, country children, M 28,334.
114. Bib. 639, 1913, Mostar, Austria, M 1360.
115. Bib. 645, 1905, Kiel and Lübeck.
116. Bib. 653, 1903, Pommerania. Taken from Stratz, Bib. 793.
117. Bib. 657, 1903, Berlin Gymnasium, M 1740.
118. Bib. 657, 1903, Berlin Volksschulen, M 1496.
119. Bib. 687, 1904, Breslau. Taken from Stratz, Bib. 793.
120. Bib. 714, 1917, poorer class, good development.
121. Bib. 714, 1917, poorer class, medium development.
122. Bib. 714, 1917, poorer class, poor development.
123. Bib. 714, 1917, well-to-do class, good development.
124. Bib. 714, 1917, well-to-do class, medium development.
125. Bib. 714, 1917, well-to-do class, poor development.
126. Bib. 723, 1901, Halle, M 958.
127. Bib. 724, 1892, Saalfeld Bürgerschulen.
128. Bib. 724, 1892, Saalfeld, country children. Taken from Ernst, Bib. 241.
129. Bib. 724, 1892, Saalfeld, city children. Taken from Ernst, Bib. 241.
130. Bib. 812 and 813, 1882, Heidelberg Volksschulen, M 480. Taken from Wiazemsky, Bib. 878.
131. Bib. 796, 1887, Radom, M 1133.
132. Bib. 175, 1896, Lausanne, M and F 2000.
133. Bib. 241, 1906, Zürich Volksschulen, M 175.
134. Bib. 549, 1903, Lausanne, poor class. Taken from Wiazemsky, Bib. 878.
135. Bib. 549, 1903, Lausanne, rich class. Taken from Wiazemsky, Bib. 878.
136. Bib. 204, 1889, Moscow factory workmen, M 5936. Taken from Wiazemsky, Bib. 878.
137. Bib. 238 and 239, 1888, Moscow, M 3212.
138. Bib. 238 and 239, 1888, Central Russia, laboring class, M 45,525.
139. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
140. Bib. 496, 1914, Wilna, Jewish children, M about 400.
141. Bib. 523, 1887, Elementarschulen. Taken from Ernst, Bib. 241.
142. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
143. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
144. Bib. 683, 1893, Moscow, Gymnasium.
145. Bib. 768, 1916, Rostow, in school, M 496.
146. Bib. 768, 1916, Rostow, not in school, M 304.
147. Bib. 774, 1897, cadets. Taken from Wiazemsky, Bib. 878.
148. Bib. 865, 1911, poor class.
149. Bib. 865, 1911, middle class.
150. Bib. 865, 1911, wealthy class.
151. Bib. 865, 1911, South Russian Jews. M 1899.
152. Bib. 878, 1907, St. Petersburg, M 1811.
153. Bib. 573 and 574, 1875-79, Turin, M 1098.

154. Bib. 573 and 574, 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
155. Bib. 573 and 574, 1875-79, Turin, well-to-do class. Taken from Ernst, Bib. 241.
156. Bib. 528, 1909.
157. Bib. 528, 1909.
158. Bib. 528, 1909.
159. Bib. 103, 1909, M 60.
160. Bib. 519, 1910, students, M 219.
161. Bib. 876, 1918, Pekin, M 5102.
162. Bib. 876, 1918, southern provinces, M 1357.
163. Bib. 103, 1909, M 1180.

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	1b Baldwin[1]	1a Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	5a Boas[6]	5b Boas[7]	6 Boas[8]	7 Boas[9]	8a Boas[10]	8b Boas[11]
5		101.6	106.9				104.9		97.4	110.0	105.5
5½		109.0	110.7								
6	114.6	114.7	112.5		112.8	112.0	110.1	112.5		118.3	109.6
6½	117.4	117.6	116.9								
7	120.9	120.0	118.4	121.7	114.1	117.1	116.1	117.5		117.0	113.8
7½	122.9	122.6	122.3	126.5							
8	125.0	125.4	124.8	126.2	118.9	122.1	121.2	122.6	129.6	120.0	121.9
8½	126.2	128.0	127.5	128.5							
9	130.8	129.8	129.9	131.3	125.0	127.0	126.1	127.7		131.5	127.2
9½	130.8	132.1	133.1	133.1							
10	134.6	135.5	134.6	134.9	130.8	133.0	131.3	133.5		133.4	133.0
10½	137.7	137.3	138.6	138.2							
11	140.0	140.1	140.3	144.0	136.9	137.2	136.6	138.9		131.2	138.7
11½	143.8	144.6	144.7	143.8							
12	145.8	146.6	146.7	146.8	143.8	144.3	142.5	145.0	134.6	143.0	143.5
12½	147.6	150.7	150.4	150.6							
13	152.9	151.1	153.5	153.7	152.4	149.9	148.7	151.6	152.8	147.6	148.8
13½	154.7	153.9	155.3	156.2							
14	157.0	155.8	157.8	158.8	155.5	153.9	153.5	156.6		153.2	152.8
14½	157.5	158.7	158.9	160.3							
15	159.0	159.0	159.0	161.8	157.2	156.9	156.5	157.7		161.3	159.2
15½	159.0	160.7	158.8	162.8							
16	159.8	160.0	161.6	163.6	159.3	157.2	158.0	159.7		166.6	161.2
16½	160.0	161.8	159.5	163.6							
17	159.8	161.1	161.3	163.6	159.3	159.1	159.1	159.7		163.3	161.8
17½	161.8	162.3	162.1	163.8							
18	162.1	162.6	160.5	163.3	160.5				158.2	165.2	161.1
18½			162.5	164.1							
19				163.8						165.4	160.2
19½				165.1							
20									152.0	166.5	161.1
21										161.4	162.5
22									150.4	166.7	160.7
23									149.3	163.3	164.2
24										162.0	159.0
25										163.7	160.9
27									158.5		
28									157.7		
29									155.3		
30									154.2		
31									148.2		
33									159.8		
35									162.1		
40									147.9		
									**		

HEIGHT OF FEMALES IN CENTIMETERS

Age in Years	American										
	8c Boas[12]	8d Boas[13]	8e Boas[14]	8f Boas[15]	8g Boas[16]	8h Boas[17]	8i Boas[18]	8j Boas[19]	8k Boas[20]	8l Boas[21]	8m Boas[22]
5	103.9	102.6	103.9	101.1	100.6	103.0		104.2	102.7	103.3	100.9
5½											
6	111.9	108.6	110.3	107.9	107.4	102.5		112.0	106.5	106.5	108.3
6½											
7	114.9	113.4	115.7	112.0	111.5			116.0	112.0	116.0	111.5
7½											
8	117.7	118.9	121.3	117.5	118.1	125.0		120.0	116.0	114.5	119.4
8½											
9	125.7	127.3	124.5	124.3	122.2	125.5	119.7	123.7	126.9	120.0	123.5
9½											
10	131.9	128.7	130.2	124.8	128.3	126.0	137.5	131.7	131.0	126.0	128.7
10½											
11	136.2	135.7	135.3	133.4	135.1	133.0	130.0	133.3	139.0	129.5	135.1
11½											
12	144.5	143.0	141.9	138.2	139.5	132.5	138.7	138.2	137.4	142.0	141.5
12½											
13	143.7	145.3	148.5	144.7	144.9	133.0	143.7	145.6	147.6	146.0	147.5
13½											
14	154.5	151.0	153.3	151.6	151.3	140.0		150.0	152.4	152.0	152.3
14½											
15	157.0	158.0	153.9	151.9	153.4	156.0	158.0	157.0	154.6		155.1
15½											
16	155.6	155.7	154.7	158.2	153.4	154.0	165.0	160.3	158.4	154.4	155.3
16½											
17	157.0		155.7	155.8	156.3	160.0	157.0	160.8	152.3	148.0	155.5
17½											
18	162.0					156.2		162.7	157.9	159.0	
18½											
19	155.5						163.0	159.9	158.0	157.8	
19½											
20	151.0						170.0	158.2	157.3	153.7	
20½											
21	164.0						159.0	159.3	161.6	155.2	
22							156.0	158.9	160.0	164.5	
23							162.0	160.3	164.0	153.2	
24							159.5	155.7	159.2	155.4	
25							163.7	157.9	159.7	158.8	
26											
27											
28											
29											
30											

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	8n Boas[23]	8o Boas[24]	9 Bowditch[25]	11a Bowditch[26]	11b Bowditch[27]	13 Gilbert[28]	14 Gilbert[29]	15b Greenwood[30]	15a Greenwood[31]	16b Greenwood[32]	16c Greenwood[33]
5	100.1	101.3	104.6								
5½											
6	108.9	107.2	110.1			114.1	113.3				
6½											
7	112.9	112.5	115.6			119.1	118.9				
7½											
8	121.1	120.5	120.9			123.0	125.0				
8½				120.6	121.8						
9	125.8	123.0	125.4			129.0	130.3				
9½				125.2	127.5						
10	132.0	127.5	130.4			134.0	134.6				
10½				130.3	131.3						
11	134.6	136.3	135.7			138.6	138.4	131.1	130.8	126.5	131.3
11½				135.7	136.4						
12	140.7	141.0	141.9			147.1	147.3	135.9	135.1	134.1	133.9
12½				141.5	142.7						
13	144.8	142.4	147.8			153.4	150.4	141.0	140.7	137.2	137.2
13½				147.4	149.1						
14	150.0	149.8	152.3			155.9	156.7	144.8	145.3	144.4	145.9
14½				152.1	153.2						
15	154.1	152.2	155.2			158.8	160.8	150.1	150.4	149.2	153.2
15½											
16	155.8	154.7	156.4			158.8	160.8	153.9	157.0	156.3	158.8
16½											
17	156.9	155.5	157.3			161.5	163.8			159.5	159.8
17½											
18	156.6	156.8	157.4				164.1			167.6	160.8
18½											
19	156.5	157.6					164.1				163.1
19½											
20	157.5	156.0									
20½											
21	156.5	156.7									
22	156.1	157.7									
23	156.2	156.8									
24	155.8	155.1									
25	157.5	156.5									
26											
27											
28											
29											
30											

HEIGHT OF FEMALES IN CENTIMETERS

	American										
Age in Years	16a Greenwood[34]	18a Hanna[35]	18b Hanna[36]	20 Hastings[37]	23a Hrdlička[38]	23b Hrdlička[39]	23c Hrdlička[40]	24a Macdonald[41]	24b Macdonald[42]	24c Macdonald[43]	25 Peckham[44]
5				105.2		98.5	100.4				106.0
5½											111.2
6				109.7	105.7	109.0	106.0	112.3			116.7
6½											120.9
7				114.7	108.1	112.6	108.7	114.6	113.8	115.5	126.5
7½											
8				119.9	110.9	125.9	113.0	120.4	119.6	121.3	
8½											
9				125.9	115.5	125.6	118.7	124.7	124.4	125.2	
9½											
10				131.1	124.6	129.4	126.7	130.1	129.0	130.8	131.8
10½											
11	128.3			134.9	128.9	130.6	130.4	134.9	134.0	135.9	136.7
11½											
12	134.1			141.8	133.6	146.7	135.7	141.7	141.1	142.4	143.5
12½											
13	143.7			148.3	137.4	147.6	143.1	147.1	146.5	148.3	149.1
13½											
14	153.0		147.8	152.9	148.3	155.9	149.5	150.4	151.8	154.1	153.7
14½		150.5									
15	157.8	148.5		156.5		155.5	153.5	156.5	156.4	156.6	156.5
15½											
16	166.6	151.8		157.6			149.8	158.5	158.0	159.3	158.0
16½		159.9	149.9								
17		158.4	151.9	159.1					160.3	160.6	159.8
17½		155.8	152.9					160.3			
18		156.5	154.2	159.5			155.4		160.8	160.3	158.8
18½		157.5	156.0								
19		158.9	156.7	159.8							
19½		160.3	158.5								
20		160.9	159.0	160.5							
20½		162.3	160.3								
21		165.5	161.3								
22		164.8	162.8								
23		165.7									
24											
27		168.5	170.2								
28		170.4									
31		173.0									
32			170.9								
		**	**								

HEIGHT OF FEMALES IN CENTIMETERS

	American								
Age in Years	26a Peckham[45]	27 Porter[46]	28 Porter[47]	29 Robertson[48]	30 Smedley[49]	33a Stiles and Wheeler[50]	33b Stiles and Wheeler[51]	34 West[52]	35 Young[53]
5								107.4	
5½									
6		107.7	107.1	115.1	109.7	114.9	114.9	111.3	110.2
6½					112.5				
7		113.0	113.0	121.2	115.4	118.9	118.9	117.6	116.3
7½					118.2				
8		118.4	118.4	126.5	120.5	123.2	124.0	121.6	124.8
8½					122.8				
9		123.7	123.7	130.6	125.3	126.5	127.9	126.6	129.8
9½					127.8				
10		128.5	128.4	137.7	130.1	131.9	132.2	132.8	133.6
10½					132.7				
11		133.1	133.2	141.0	135.4	137.1	138.0	137.0	140.9
11½					138.3				
12	142.0	139.2	139.1	147.3	141.3	143.8	143.9	144.7	146.6
12½					144.3				
13	143.5	146.6	146.5	155.2	147.7	152.3	152.8	147.9	147.3
13½					151.1				
14	150.1	150.6	150.8	158.5	153.6	153.1	152.7	153.7	155.6
14½					156.3				
15	156.5	154.9	155.0		156.9	156.7	156.9	157.0	160.9
15½					157.5				
16	161.3	157.5	157.5		158.3	158.5	158.8	158.5	159.2
16½					159.2				
17	162.1	159.3	159.3		159.3	159.4	159.5	159.5	158.9
17½					159.4				
18	162.1	159.5	159.4		159.4			159.0	155.9
18½					159.5				
19	162.1	158.5	158.5					159.3	
19½									
20			159.4					159.0	
20½									
21			160.0					159.3	
22									
23									
24									
25									
26									
27									
28									
29									
30									

HEIGHT OF FEMALES IN CENTIMETERS

	Canadian	Amer. & Engl.	English								
Age in Years	36 Boas[54]	37 Stephenson[55]	38 Berry[56]	39a Elderton[57]	39b Elderton[58]	40 Galton[59]	41 Galton[60]	42 Kerr[61]	44a Roberts[62]	45 Shuttleworth[63]	46 Stanway[64]
5	105.0	104.3				97.3	102.9		103.7	108.7	
5½											
6	110.3	109.2		104.1	108.5	103.1	108.7	119.0	108.3	112.9	
6½											
7	115.9	114.3		109.0	113.8	109.0	113.0	124.0	112.9	118.4	
7½											
8	120.5	119.6		113.3	117.9	113.0	118.4	129.0	118.4	123.8	
8½											
9	125.1	124.6		118.4	123.4	118.4	123.7	135.0	123.8	129.7	
9½											
10	130.7	130.0		123.2	128.0	123.7	129.5	141.0	131.7	134.9	125.7
10½											
11	135.9	135.3	139.7	127.8	132.6	129.8	134.9	147.0	134.9	141.4	131.3
11½											
12	141.6	141.7	144.8	133.1	137.4	134.9	141.2	156.0	141.1	146.7	136.1
12½											
13	148.1	147.2	147.3	138.2	143.5	144.0	146.6	162.0	146.7	151.9	141.2
13½											
14	152.8	152.1	156.2	141.7	149.1	146.8	151.9	166.0	151.9	154.8	147.1
14½											
15		155.0	157.5			151.9	154.7	167.0	154.8	156.9	149.1
15½											
16		156.6				154.7	156.7	168.0	156.9	158.8	151.1
16½											
17		158.0				156.7	158.8	168.0	158.8	158.6	154.2
17½											
18		158.0				158.8	158.5		158.6	159.4	
18½											
19						158.5	159.3		159.4	160.0	
19½											
20						159.5	159.8		160.0	160.1	
20½											
21						160.0	160.0		160.1	159.7	
22						160.0			159.7	160.1	
23									160.1	159.3	
24									159.3		
25											
28										157.5	

HEIGHT OF FEMALES IN CENTIMETERS

	English			Norwegian				Swedish		Danish	
Age in Years	49a Tuxford & Glegg[65]	49b Tuxford & Glegg[66]	49c Tuxford & Glegg[67]	50 Schiötz[68]	51a Schiötz[69]	51b Schiötz[70]	51c Schiötz[71]	52a Key[72]	52b Key[73]	53a Hertel[74]	53b Hertel[75]
5	102.6	103.1	102.0								
5½											
6	107.6	108.0	107.2		115.2			113.0		112.0	
6½											
7	113.9	114.6	113.4		117.8	121.1	119.5	116.0		115.0	
7½											
8	117.6	117.8	117.5		123.0	127.0	125.0	123.0		120.0	
8½									121.0		
9	123.7	125.6	122.6		127.4	132.4	128.3	127.0		125.0	
9½									125.0		
10	129.8	130.2	129.4		131.8	136.5	133.9	132.0		130.0	
10½									130.0		
11	133.5	135.6	132.3		136.4	140.2	138.2	137.0		133.0	
11½									134.0		135.0
12	138.7	138.5	139.3	147.2	142.7	148.2	144.6	143.0		138.0	
12½									140.0		141.0
13	144.5	145.1	144.0	150.3	148.2	153.8	139.6	148.0		146.0	
13½									146.0		149.0
14	149.0	149.8	148.7	157.5	151.7	158.1	156.1	153.0		151.0	
14½									151.0		154.0
15				159.7				157.0		154.0	
15½									154.0		
16				160.3				159.0		159.0	
16½											
17				161.1				160.0			
17½											
18								160.0			
18½											
19								162.0			
19½											
20								160.0			
20½											
21											
22											
23											
24											
25											
26											

HEIGHT OF FEMALES IN CENTIMETERS

	Bel.	Fr.	German								
Age in Years	55 Quetelet[76]	58 Variot & Chaumet[77]	59a Ascher[78]	59b Ascher[79]	63 Daffner[80]	64 Geissler[81]	65a Geissler und Uhlitzsch[82]	65b. Geissler und Uhlitzsch[83]	66a Hasse[84]	66b Hasse[85]	70 Radosavljevich[86]
5	97.3										
5½		101.9									
6	103.1										111.4
6½		108.9	110.0	110.0		109.3	111.2	107.3			
7	108.7										116.6
7½		113.8	115.0	116.0		113.7	115.2	111.6			
8	114.2										121.4
8½		119.5	122.0	120.0		117.7	119.1	116.3	120.5	116.4	
9	119.6										127.0
9½		124.7	125.0	123.0		124.0	124.2	120.4	126.0	123.2	
10	124.9										131.0
10½		129.5	132.0	129.0		128.6	129.7	125.2	130.2	128.1	
11	130.1										135.9
11½		134.4	134.0	135.0		133.9	134.2	130.3	135.1	133.4	
12	135.2										141.1
12½		141.5	144.0	140.0		139.5	138.3	135.7	142.0	138.4	
13	140.0										148.5
13½		148.6	147.0	145.0		145.1	145.8	140.7	147.2	144.3	
14	144.6										154.1
14½		152.9							150.6	147.7	
15	148.8										160.0
15½		154.2									
16	152.2				150.1						
16½											
17	154.7				151.9						
17½											
18	156.2				153.9						
18½											
19	157.0				156.0						
19½											
20	157.5				157.5						
21					159.0						
22					160.5						
23					162.1						
24					164.1						
25					166.6						
26					168.4						

HEIGHT OF FEMALES IN CENTIMETERS

	German									Swiss	
Age in Years	71 Ranke[87]	72 Reuter[88]	73a Rietz[89]	73b Rietz[90]	74 Samosch[91]	76 Schmid-Monnard[92]	77a Schmidt[93]	77c Schmidt[94]	77b Schmidt[95]	80 Combe[96]	81 Ernst[97]
5	97.0					99.7					
5½											
6	107.3	110.0	118.8	111.7	108.0	110.8					
6½							108.5				
7	113.6	114.0	121.5	117.0	114.0	115.2				116.3	
7½							114.1				
8	116.5	124.0	127.2	121.7	118.0	119.8				121.2	
8½							118.5	117.8	119.1		123.7
9	123.3	127.0	131.0	125.0	124.0	124.7				125.7	
9½							123.9	123.2	124.4		125.0
10	127.3	131.0	135.7	130.6	128.0	128.8				131.1	
10½							129.2	128.0	130.1		133.6
11	131.8	134.0	141.2	135.7	134.0	134.5				136.4	
11½							133.6	133.3	133.7		137.1
12	136.9	140.0	147.8	140.8	138.0	139.4				142.0	
12½							138.7	138.0	139.2		140.0
13	141.1	144.0	152.1	148.1	145.0	145.4				147.1	
13½							144.2	143.0	145.0		148.4
14	146.2		156.6	150.5	148.0	151.8					
14½											150.3
15	147.5		157.7								
15½											
16											
16½											
17											
17½											
18											
18½											
19											
19½											
20											
20½											
21											
22											
23											
24											
25											

HEIGHT OF FEMALES IN CENTIMETERS

	Russian						Italian			Japanese	
Age in Years	86a Erismann[98]	86b Erismann[99]	87a Kosmowski[100]	89b Michailoff[101]	89a Michailoff[102]	94d Weissenberg[103]	96a Pagliani[104]	96c Pagliani[105]	96b Pagliani[106]	99a Misawa[107]	98 Misawa[108]
5						99.8	96.5			96.5	
5½											
6						106.6	102.1			102.4	
6½											
7	111.5					112.4	109.2			107.2	105.3
7½											
8	116.3	118.8				116.7	115.6			112.0	109.5
8½			116.6	116.4	117.6			111.8	120.2		
9	119.6	123.0				122.1	120.9			116.2	114.1
9½			120.2	119.6	121.6			118.0	124.8		
10	125.0	129.5				127.4	127.3			120.4	118.5
10½			125.2	125.0	125.1			124.2	130.6		
11	129.8	131.0				132.2	131.3			125.9	123.2
11½			130.2	129.7	128.5			130.0	133.5		
12	132.8	135.5				139.2	136.7			132.3	128.3
12½			135.1	132.9	133.1			135.2	139.4		
13	138.4	139.9				144.0	142.5			139.0	133.3
13½			138.4	138.3	137.8			138.3	146.4		
14	145.8	143.5				149.3	149.6			143.2	137.7
14½			144.0	145.8				144.5	152.1		
15		148.2				150.6	152.7			144.7	141.6
15½				146.4							
16		151.0				151.6	153.9				143.7
16½				150.3							
17		152.4				153.1	154.9				
17½											
18		152.8				154.0	154.9				
18½											
19		153.3				153.8					
20		153.0				153.7					
21		153.1				**					
22		153.3									
23		153.2									
24		153.5									
25		152.9									
26		153.1									
27		153.1									
28		153.1									
29		153.4									
30		**									

HEIGHT OF FEMALES IN CENTIMETERS

	Chinese		Philippine
Age in Years	102 Merrins[109]	103a Whyte[110]	104 Bobbitt[111]
5			
5½			
6			
6½			
7			114.5
7½			
8			117.5
8½			
9			123.2
9½			
10			127.3
10½			
11		130.0	128.3
11½			
12	132.6	133.8	134.8
12½			
13	139.7	139.5	142.5
13½			
14	145.3	141.0	145.5
14½			
15	147.3	147.3	148.0
15½			
16	149.9	147.3	148.8
16½			
17	150.4	146.5	150.0
17½			
18		150.7	149.0
18½			
19	152.4	151.3	149.6
19½			
20			148.6
20½			
21	153.7		
22			
23			
24			
25			
26			
27			
28			
29			
30			

III. SCHOOL CHILDREN AND ADULTS. HEIGHT OF FEMALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, F 706, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School. Well-to-do class, F 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, F 60, consecutive measurements. Includes data of final norms page 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, F 47, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 88, 1897, American, F 1967.
7. Bib. 88, 1897, American, F 43,298.
8. Bib. 88, 1897, Oakland, F 2377.
9. Bib. 80, 1891, half bloods and Indians of North Pacific Coast.
10. Bib. 95, 1911, American born Scotch, F 78.
11. Bib. 95, 1911, American born Bohemian, F 674.
12. Bib. 95, 1911, American born Hungarian and Slovak, F 112.
13. Bib. 95, 1911, American born Polish, F 85.
14. Bib. 95, 1911, American born Hebrew, F 552.
15. Bib. 95, 1911, American born Sicilian, F 270.
16. Bib. 95, 1911, American born Neopolitan, F 439.
17. Bib. 95, 1911, American born Italian, F 24.
18. Bib. 95, 1911, foreign born Scotch, F 39.
19. Bib. 95, 1911, foreign born Bohemian, F 160.
20. Bib. 95, 1911, foreign born Hungarian and Slovak, F 102.
21. Bib. 95, 1911, foreign born Polish, F 84.
22. Bib. 95, 1911, foreign born Hebrew, F 359.
23. Bib. 95, 1911, foreign born Sicilian, F 744.
24. Bib. 95, 1911, foreign born Neopolitan, F 339.
25. Bib. 109, 1875, Boston, F 10,904.
26. Bib. 110, 1879, Boston, laboring class. Taken from Ernst, Bib. 241.
27. Bib. 110, 1879, Boston, non-laboring class. Taken from Ernst Bib. 241.
28. Bib. 294, 1895, New Haven, F 584.
29. Bib. 295, 1897, Iowa, F 50.
30. Bib. 317, 1890, negroes, M and F 223.
31. Bib. 317, 1890, American white, M and F 724.
32. Bib. 317, 1890, negroes, M and F 574.
33. Bib. 317, 1890, Kansas City, white, M and F 2619.
34. Bib. 317, 1890, foreign descent, M and F 385.
35. Bib. 345, 1893, Oberlin College, F 500.
36. Bib. 345, 1893, Oberlin College, M and F 1600.
37. Bib. 356, 1902, Nebraska, F 7069.
38. Bib. 403, 1899, Italian descent.
39. Bib. 403, 1899, New York, negro asylum children.
40. Bib. 403, 1899, New York, white asylum children.
41. Bib. 490, 1897-98, Washington, D. C., F 8520.
42. Bib. 490, 1897-98, Washington, D. C., laboring class.
43. Bib. 490, 1897-98, Washington, D. C., non-laboring class.
44. Bib. 580, 1881, Milwaukee, F 4891.
45. Bib. 580, 1881.
46. Bib. 614, 1893, St. Louis, F 18,059.
47. Bib. 615, 1894, St. Louis, F 16,527.
48. Bib. 669a, 1916, Oakland.
49. Bib. 764, 1900, Chicago, F 3471.
50. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, F 881.

51. Bib. 782, 1915, southern states, homes of good sanitary condition, F 657.
52. Bib. 873, 1896, Worcester, M and F 3250.
53. Bib. 900, 1913 Chicago, favored class, F 144.
54. Bib. 95, 1911, Toronto.
55. Bib. 778, 1888.
56. Bib. 58, 1904, London, scholarship girls, F 1384.
57. Bib. 229, 1914, Glasgow, poorer class.
58. Bib. 229, 1914, Glasgow, better class.
59. Bib. 281, 1883, schools, military and naval colleges, M and F 29, 405.
60. Bib. 281, 1883, all classes.
61. Bib. 427, 1918.
62. Bib. 663, 1878, all classes, M and F 30,000.
63. Bib. 752, 1884, general population.
64. Bib. 773, 1833, Manchester.
65. Bib. 827, 1911, all England, F 258,834.
66. Bib. 827, 1911, county education areas, F 121,648.
67. Bib. 827, 1911, urban education areas, F 137,186.
68. Bib. 706, 1919, Kristiania, F 177.
69. Bib. 704, 1917, F 4204.
70. Bib. 704, 1917, Kristiania, better class, F 394.
71. Bib. 704, 1917, Kristiania, better class, Volksschule, F 426.
72. Bib. 431, 1889, F 3000.
73. Bib. 431, 1889, Volksschulen. Taken from Ernst, Bib. 241.
74. Bib. 368, 1882, F 11,250.
75. Bib. 368, 1882, höhere Schulen.
76. Bib. 628, 1836, F 10 at each age.
77. Bib. 838, 1906, Paris, poorer class.
78. Bib. 18, 1912, Hamm.
79. Bib. 18, 1912, Königsberg.
80. Bib. 190, 1884.
81. Bib. 291 and 292, 1888, Gohlis-Leipzig Bürgerschule, F 1420.
82. Bib. 291 and 292, 1888, Freiberg Bürgerschule, F 10,830.
83. Bib. 291 and 292, 1888, Freiberg mountaineers' children, Volksschulen.
84. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
85. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 2. Taken from Ernst, Bib. 241.
86. Bib. 639, 1913, Mostar, Austria, F 615.
87. Bib. 645, 1905, Kiel and Lübeck, F 1000.
88. Bib. 653, 1903, Pommerania. Taken from Stratz, Bib. 793.
89. Bib. 657, 1903, Berlin, Gymnasium, F 533.
90. Bib. 657, 1903, Berlin, Volksschulen, F 1365.
91. Bib. 687, 1904, Breslau. Taken from Stratz, Bib. 793.
92. Bib. 723, 1901, Halle, F 906.
93. Bib. 724, 1892, Saalfeld, Bürgerschulen.
94. Bib. 724, 1892, Saalfeld, city children. Taken from Ernst, Bib. 241.
95. Bib. 724, 1892, Saalfeld, country children. Taken from Ernst, Bib. 241.
96. Bib. 175, 1896, Lausanne, M and F 2000.
97. Bib. 241, 1906, Zürich, Volksschulen, F 175.
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108. Bib. 528, 1909.
109. Bib. 519, 1910, students, F 69.
110. Bib. 876, 1918, southern provinces, F 613.
111. Bib. 103, 1909, F 438.

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	1a Baldwin[1]	1b Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	4 Beyer[6]	6 Boas[7]	5a Boas[8]	8b Boas[9]	8c Boas[10]	8e Boas[11]
5	17.3		19.0								
5½	18.6		18.9								
6	19.5	21.3	20.5		21.6		21.6	20.7			
6½	20.3	23.1	21.8								
7	21.3	22.5	23.0	24.3	22.8		23.5	22.6			
7½	23.3	25.5	23.2	25.5							
8	24.6	25.9	25.3	26.9	24.6		26.0	24.5			25.4
8½	25.4	27.2	25.4	27.3							
9	27.4	26.6	27.6	28.1	27.0		28.2	26.9	27.2	24.3	26.0
9½	28.2	28.4	29.2	30.6							
10	30.4	30.5	30.9	30.7	30.3		31.3	29.8	28.6	30.5	27.9
10½	32.4	31.2	32.1	32.4							
11	33.3	32.3	33.7	34.1	32.7		33.9	32.3	31.6	31.0	30.8
11½	34.3	33.0	35.4	36.3							
12	36.7	34.8	35.0	37.3	35.3		37.0	35.6	33.3	32.9	33.1
12½	38.4	35.3	39.2	38.8							
13	40.6	39.0	40.1	41.7	40.6		40.4	39.4	38.3	37.0	37.1
13½	39.8	39.5	44.0	45.3							
14	43.1	43.6	44.7	47.4	44.0		47.7	44.5	41.1	38.0	42.3
14½	44.9	46.5	47.8	50.1							
15	47.6	48.8	49.4	53.3	49.0	48.5	54.2	51.6	42.7	42.7	44.6
15½	52.6	49.2	54.9	56.7							
16	53.9	50.8	54.3	58.1	55.2	53.5		55.6	37.0		49.1
16½	57.7	51.9	59.9	61.7							
17	58.3	56.6	56.6	63.1	59.7	56.7		60.2			
17½	57.6	58.3	60.4	63.6							
18	58.5	59.2	61.6	65.1	62.5	60.5					
18½			58.5	64.1							
19						63.4					
19½											
20						64.1					
20½											
21						63.5					
22						64.1					
23						65.3					
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

	American										
Age in Years	8f Boas[12]	8g Boas[13]	8j Boas[14]	8k Boas[15]	8m Boas[16]	8n Boas[17]	8o Boas[18]	9 Bowditch[19]	10 Bowditch[20]	11a Bowditch[21]	11b Bowditch[22]
5								18.7			
5½											
6								20.5			
6½											
7								22.3			
7½											
8						23.0		24.5			
8½										24.3	24.8
9	27.0	26.9	27.0	31.0		33.0	27.0	26.9			
9½										26.9	27.2
10	27.3	27.1	30.5	26.8	27.4	30.0	26.8	29.6	32.0		
10½										29.6	30.1
11	30.1	30.6	30.1	31.1	30.8	29.8	31.6	31.8	34.2		
11½										31.6	32.6
12	32.3	32.7	34.9	32.0	32.3	33.3	33.0	34.9	39.0		
12½										34.4	36.5
13	35.8	36.1	41.1	36.2	35.9	35.8	35.5	38.5	42.8		
13½										37.8	40.2
14	40.5	39.5	41.9	39.2	41.4	39.4	39.2	43.1	45.3		
14½										42.5	43.8
15	41.4	42.0	44.0		44.6	42.9	42.9	48.6	52.9		
15½										47.6	49.3
16	56.0	47.8			50.4	40.0	52.6	54.9	57.1		
16½											
17		41.0					55.5	57.8	61.3		
17½											
18								60.1	62.7		
18½											
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

Age in Years	American										
	12 Cordeiro[23]	13 Gilbert[24]	14 Gilbert[25]	15a Greenwood[26]	15b Greenwood[27]	16c Greenwood[28]	16a Greenwood[29]	17 Hall[30]	19a Hastings[31]	19b Hastings[32]	20 Hastings[33]
5											17.8
5½											
6		21.2	20.8								19.3
6½											
7		23.2	23.3								21.3
7½											
8		23.8	25.0								23.1
8½											
9		27.2	27.9					26.5			25.0
9½											
10		31.0	28.9					30.0			27.8
10½											
11		32.1	32.8	30.1	31.2	30.6		32.5			29.8
11½											
12		37.3	35.5	33.2	32.4	32.2	34.8	36.5			32.9
12½											
13		39.9	41.2	36.9	39.7	35.5	35.2	40.7			35.5
13½											
14	39.1	41.6	46.3	39.6	41.9	39.7	41.5	45.2			39.6
14½											
15	43.7	49.9	53.1	41.8	44.6	42.4	48.1	49.3			46.9
15½											
16	49.7	57.6	59.0	48.7	49.8	50.5	48.5	57.0			52.8
16½											
17	54.5	59.0	63.6			54.0		60.7	59.8	59.9	56.7
17½											
18			64.7			57.4		62.9	60.4	60.8	59.1
19			66.0			62.1		63.8	61.4	61.6	61.6
20								64.7	62.7	62.7	61.0
21								65.8	63.3	63.5	
22									63.9	64.0	
23									63.8	64.1	
24									64.5	64.6	
25									65.8	65.8	
26									65.4	65.7	
27									65.3	65.5	
28									64.0	63.8	
29									64.7	64.7	
30									66.5	66.5	

WEIGHT OF MALES IN KILOGRAMS

	American									
Age in Years	21 Hastings[34]	23a Hrdlička[35]	23d Hrdlička[36]	24a Macdonald[37]	25 Peckham[38]	27 Porter[39]	28 Porter[40]	29 Robertson[41]	30 Smedley[42]	33a Stiles and Wheeler[43]	33b Stiles and Wheeler[44]
5	17.8		15.0	20.5	18.7						
5½											
6	19.3	17.6	18.1	21.7	20.3	19.8	19.8	20.9	19.7	20.2	19.7
6½									20.7		
7	21.3	20.3	20.4	23.4	22.3	21.7	21.7	23.0	21.6	22.8	22.7
7½									22.6		
8	23.1	21.0	21.3	25.5	24.4	23.8	23.8	25.1	23.8	24.6	24.7
8½									25.1		
9	25.0	24.0	24.0	27.9	27.0	26.1	26.1	29.0	26.3	26.2	26.1
9½									27.6		
10	27.8	25.5	25.9	30.0	29.7	28.3	28.3	30.4	28.7	29.2	29.5
10½									29.8		
11	29.4	28.0	29.0	33.0	32.2	31.0	31.0	34.4	31.2	31.5	31.6
11½									32.6		
12	32.9	31.3	31.8	36.0	34.5	33.5	33.5	36.9	34.2	36.1	35.3
12½									35.7		
13	35.5	32.7	36.7	40.1	38.5	36.6	36.6	42.0	38.1	39.6	39.0
13½									40.5		
14	39.7	38.6	38.1	45.8	43.5	40.4	40.5	47.0	42.7	42.4	42.0
14½									44.9		
15	46.9	34.5	38.6	51.6	49.4	46.2	46.2		48.0	49.5	50.1
15½									51.1		
16	52.8		52.2	55.0	55.4	51.6	51.6		53.3	49.6	50.1
16½									55.4		
17			55.3	59.9	59.2	55.7	55.7		57.4	57.4	56.8
17½									59.4		
18				60.0	62.5		55.9		61.3		
18½									63.2		
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF MALES IN KILOGRAMS

	American		Am&En	English						
Age in Years	34 West[45]	35 Young[46]	37 Stephenson[47]	39a Elderton[48]	39b Elderton[49]	40 Galton[50]	41 Galton[51]	42 Kerr[52]	43 Maclaren[53]	44a Roberts[54]
5	19.3		18.4				18.1			18.1
5½										
6	20.9	22.0	20.3	18.6	19.6		20.1	21.5		20.1
6½										
7	22.4	24.5	22.4	20.1	21.1		22.6	24.1		22.6
7½										
8	24.3	26.9	24.7	21.8	23.2		24.9	26.6		24.9
8½										
9	27.1	30.3	27.1	23.7	25.5		27.4	29.1		27.4
9½										
10	30.2	30.9	30.1	25.7	27.8	33.6	30.6	32.0	29.5	30.6
10½										
11	32.2	33.6	32.2	27.9	30.1	35.7	32.7	35.1	31.8	32.7
11½										
12	35.7	40.0	34.8	30.1	32.1	38.5	34.8	38.4	35.5	34.8
12½										
13	39.1	48.1	38.0	32.5	34.9	41.5	37.2	42.0	38.1	37.5
13½										
14	44.5	47.6	42.4	34.3	37.7	46.3	41.7	46.1	42.2	41.7
14½										
15	50.9	36.8	47.6			51.9	46.6	51.1	47.0	46.6
15½										
16	56.1	43.7	54.4			58.7	54.0	56.0	52.9	54.0
17	60.3		58.6			64.3	59.0	59.3	58.3	59.4
18	60.4		61.2			66.4	62.3		62.1	62.3
19	64.7					67.3	63.3			63.3
20						69.1	65.0			65.0
21						69.3	65.9			65.9
22						69.3				66.6
23										67.0
24										67.1
25										67.7
26										68.8
27										69.1
28										69.8
29										69.9
30										72.5
31										
32										
33										
34										

WEIGHT OF MALES IN KILOGRAMS

	English										
Age in Years	44b Roberts[53]	44c Roberts[56]	44d Roberts[57]	44e Roberts[58]	44f Roberts[59]	44h Roberts[60]	44g Roberts[61]	45 Shuttleworth[62]	47a Stephenson[63]	47b Stephenson[64]	48 Thorne[65]
5	16.9	22.7									
5½											
6	18.4	24.6									
6½											
7	20.6	25.8				24.9					
7½											
8	22.1	26.8				27.2		25.0			
8½				25.0							
9	24.3	28.4				28.1		27.2			25.4
9½				26.6							
10	25.6	30.1	30.6			30.1		29.5	29.9	30.4	31.8
10½				28.2	28.8						
11	26.9	31.5	33.1			31.6	30.1	31.8	31.8	33.1	32.9
11½				29.5	31.1						
12	28.6	33.4	36.4			34.1	31.5	35.2	33.6	36.3	34.7
12½				31.3	34.3						
13	32.1	35.5	40.2			37.2	33.4	38.6	35.4	39.9	38.1
13½				33.2	37.8						
14	36.6	38.4	45.0			41.8	35.5	42.0	38.1	44.5	44.5
14½				35.9	42.3						
15	43.5	43.9	50.1			47.8	37.0	46.5	42.6	49.9	50.8
15½				41.1	47.1						
16	50.3	49.3	58.2			53.9	43.9	53.3	48.1	57.2	50.8
16½				46.2	54.7						
17	56.3	52.8	64.0			57.8	49.3	61.2	52.6	63.5	
17½											
18	58.7	55.9	66.2			63.5	52.8	64.6	55.3	66.2	
18½											
19	60.6	58.2	67.3			64.0	55.9	65.2	58.1	67.1	
19½											
20	61.9	59.2	69.0				58.2	65.8	59.9	68.0	
20½											
21	62.6		69.1				59.2	66.3	61.7	69.0	
22	63.1		70.2					66.9			
23											
24											
25											
27	64.0										
28								67.5			

WEIGHT OF MALES IN KILOGRAMS

	English			Norwegian	Swedish		Danish		Belgian	French	
Age in Years	49a Tuxford and Glegg[66]	49b Tuxford and Glegg[67]	49c Tuxford and Glegg[68]	50 Schiötz[69]	52a Key[70]	52b Key[71]	53a Hertel[72]	53b Hertel[73]	55 Quetelet[74]	57 Godin[75]	58 Variot and Chaumet[76]
5	17.5	17.7	17.3						15.9		
5½											15.9
6	19.3	19.4	19.3		20.5				17.8		
6½						21.8	21.0				17.5
7	21.2	21.8	21.0		22.8				19.7		
7½						22.5	22.5				19.0
8	22.9	23.3	22.8		26.2				21.6		
8½						25.8	24.0				21.1
9	25.1	25.9	24.7		29.3				23.5		
9½						26.3	26.0				23.8
10	27.4	27.8	27.2		30.3				25.2		
10½						28.7	28.5				25.6
11	29.9	30.8	29.5		32.2				27.0		
11½						33.6	31.0	33.0			27.7
12	33.1	33.3	32.5	35.0	34.5				29.0		
12½						33.0	33.5	35.0			30.1
13	35.2	35.3	35.0	37.6	37.6				33.1		
13½						36.0	36.5	37.5		37.5	35.7
14	38.2	38.3	38.1	42.6	42.3				37.1	39.3	
14½						37.0	40.5	41.5		41.9	41.9
15				50.0	46.8				41.2	44.1	
15½						44.3	46.5	46.5		47.2	47.5
16				54.3	52.3				45.4	50.3	
16½							53.0	53.0		53.0	
17				59.5	57.6				49.7	54.8	
17½							57.5			56.5	
18					61.3				53.9		
18½							61.0				
19					63.3				57.6		
19½											
20					65.2				59.5		
20½											
21											
22											
23											

WEIGHT OF MALES IN KILOGRAMS

	German									
Age in Years	59b Ascher[77]	59a Ascher[78]	60 Camerer[79]	62 Daffner[80]	64 Geissler[81]	66b Hasse[82]	66a Hasse[83]	67 Kotelmann[84]	69b Peiper[85]	69c Peiper[86]
5			19.3							
5½										
6			21.1		21.4					
6½	20.2	19.8							18.9	19.1
7			23.0		22.9					
7½	21.8	21.8							20.5	21.1
8			24.9		24.7					
8½	23.7	24.0				24.3	25.2	26.9	22.6	23.7
9			26.8		26.7					
9½	26.0	26.0				26.1	27.9	28.3	24.6	25.1
10			29.4		28.8					
10½	28.0	27.4				28.2	28.5	30.7	26.8	27.3
11			32.1		32.0					
11½	31.1	30.7				30.6	31.6	33.9	29.6	29.9
12			34.9		34.6					
12½	33.8	34.4				34.2	35.3	35.8	32.3	32.4
13			38.2	34.5	36.0					
13½	36.7	37.1				35.7	36.4	41.0	35.3	35.5
14			42.6	38.1						
14½						38.8	41.1	45.9		
15			51.0	43.6						
15½								51.9		
16			57.1	45.5						
16½										
17			62.7	48.5						
17½										
18			66.0	56.5						
18½										
19				55.6						
19½										
20				57.0						
20½										
21				57.2						
22				66.2						
23										
24										
25										
26										
27										
28										

WEIGHT OF MALES IN KILOGRAMS

	German										
Age in Years	69a Peiper[87]	70 Radosavljevich[88]	73b Rietz[89]	73c Rietz[90]	73a Rietz[91]	75a Schlesinger[92]	75b Schlesinger[93]	75c Schlesinger[94]	75d Schlesinger[95]	75e Schlesinger[96]	75f Schlesinger[97]
5											
5½											
6		19.8	20.1		22.5	18.9	18.2	15.5	22.9	18.5	17.1
6½	19.0										
7		21.0	21.6		24.3	22.4	18.9		23.9	20.1	18.3
7½	20.9										
8		23.9	23.3		26.0	24.1	20.4	18.5	26.3	21.5	19.8
8½	22.9			26.2							
9		26.9	25.7		27.7	26.5	22.6	19.2	29.6	24.0	21.6
9½	25.0			27.8							
10		28.9	27.6		32.0	29.1	24.1	20.1	30.9	26.0	22.6
10½	27.0			30.6							
11		31.9	29.9		34.3	30.3	25.8	22.4	33.9	26.4	23.7
11½	29.6			33.1							
12		34.0	32.8		40.4	35.5	29.1	25.4	37.5	29.7	25.7
12½	32.4			37.1							
13		37.9	36.4		43.0	39.2	31.9	29.7	42.8	33.1	29.4
13½	35.4			41.6							
14		43.2	37.4		50.0	45.0	36.5	31.6	47.0	36.0	30.3
14½				46.0							
15		48.2			51.1	49.2	38.5	33.5	53.4	41.5	36.6
15½				51.7							
16		54.0				55.1	42.4	38.4	58.3	47.2	41.2
16½				56.3							
17		57.8							62.9	52.8	48.4
17½											
18		62.0							65.6	55.7	
18½											
19		62.9							69.0	57.9	53.2
19½											
20		62.9							69.0	57.0	
20½											
21											
22											
23											
24											
25											
26											
27											

WEIGHT OF MALES IN KILOGRAMS

	German		Polish	Swiss		Russian					
Age in Years	76 Schmid-Monnard[98]	77a Schmidt[99]	79 Suligowski[100]	82 · Ernst[101]	81 Ernst[102]	84 Dementiew[103]	85c Diek[104]	86b Erismann[105]	86a Erismann[106]	87b Kosmowski[107]	87a Kosmowski[108]
5	16.1										
5½											
6	18.4	19.0							20.0		
6½											
7	19.8	21.2							22.0		
7½										22.4	
8	21.5	23.2							24.1		
8½			25.1		24.7					22.6	22.6
9	23.5	25.3		22.5					27.7		
9½			28.0		25.3					23.8	23.8
10	25.7	26.6		22.5		28.0		27.6	30.5		
10½			30.8		27.3		28.7			26.0	26.0
11	27.8	29.8		23.4		29.4		29.1	33.3		
11½			33.3		30.0		30.4			28.3	28.3
12	30.5	32.2		24.0		31.1		30.9	37.6		
12½			37.2		32.3		32.6			31.0	31.0
13	33.6	35.0		24.8		32.5		32.7	41.5		
13½			41.7		36.2		37.7			32.0	32.0
14	38.0	36.2		25.7		35.7		35.2	46.6		
14½			47.0		37.7		41.0			36.6	36.0
15				26.0		39.9		39.4	53.0		
15½			51.0				47.2				
16						44.5		44.0	57.4		
16½			56.0				52.6				
17						49.9		49.8	60.1		
17½			57.5				55.6				
18						64.6		53.9			
18½			57.7								
19						56.5		56.0			
19½			59.3								
20											
20½			62.1								
21											

WEIGHT OF MALES IN KILOGRAMS

	Russian										
Age in Years	88 Makower[109]	89a Michailoff[110]	89b Michailoff[111]	90c Mouratow[112]	91 Sack[113]	92a Spielrein[114]	92b Spielrein[115]	93 Starkow[116]	94a Weissenberg[117]	94b Weissenberg[118]	94c Weissenberg[119]
5											
5½											
6							20.2				
6½											
7						23.0	21.6				
7½											
8	26.0					24.5	24.0				
8½		22.2	22.0		23.6						
9	27.3					25.7	24.4				
9½		23.4	24.1		26.7						
10	30.2					28.0	27.7	29.8	26.0	25.7	26.2
10½		25.9	27.7	28.7	28.7						
11	32.5					29.8	29.9	32.8	27.0	27.3	27.3
11½		28.3	30.5	29.1	31.1						
12	36.2					31.9	34.8	35.2	29.0	30.8	32.0
12½		29.8	33.3	32.8	34.0						
13	41.2					36.4	34.8	39.5	32.2	33.3	34.7
13½		31.6	37.6	31.6	37.5						
14	43.9					37.7	38.3	44.5			
14½			41.5	35.3	43.9						
15	50.6						42.1	50.9			
15½			46.6	32.8	49.2						
16	54.4							56.1			
16½			53.0	37.8	53.7						
17	56.4							58.7			
17½				48.1							
18	56.9							59.4			
18½				51.1							
19	57.2							62.5			
19½				57.0							
20	57.7										
20½				53.2							
21	58.2										
22											
23											
24											
25											
26								64.3			
27											
28											

WEIGHT OF MALES IN KILOGRAMS

	Russian		Italian				Japanese			
Age in Years	94d Weissenberg[120]	95 Wiazemsky[121]	96a Pagliani[122]	96c Pagliani[123]	96b Pagliani[124]	97 Vitale-Vitali[125]	98 Misawa[126]	99a Misawa[127]	99b Misawa[128]	100 Miwa[129]
5	16.2		15.2					15.2		16.4
5½										
6	19.2		16.7					16.5		17.2
6½										
7	20.0		19.4				17.6	17.8		19.0
7½										
8	22.1		20.7				19.1	19.1		20.3
8½				22.7	20.5					
9	24.5		22.4				21.1	21.0		22.4
9½				25.7	21.8					
10	25.7	28.1	24.8				22.8	23.0		23.9
10½				27.5	24.4	24.3				
11	27.3	31.4	26.6				25.0	25.0		25.9
11½				30.7	26.0	26.5				
12	30.8	32.1	29.3				27.0	27.2		28.2
12½				30.0	28.0	27.6				
13	33.3	35.5	33.0				29.4	29.8	37.8	32.7
13½				35.5	31.5	30.0				
14	37.9	40.2	36.6				32.5	33.6	42.1	37.8
14½				41.7	32.3	32.6				
15	41.0	45.0	41.8				35.2	38.7	47.4	45.0
15½				46.4	39.5	34.1				
16	46.3	51.3	47.2				38.2		51.0	45.4
16½						36.1				
17	51.4	55.6	52.7						52.3	49.7
17½						39.1				
18	54.0	58.0	53.8							49.1
18½						38.1				
19	56.8	59.5	55.0							50.9
19½						39.7				
20	56.6									50.8
20½										
21										51.0
22										
23										
24										
26		59.8								

WEIGHT OF MALES IN KILOGRAMS

	Chinese				Philippine
Age in Years	101 Bobbitt[130]	102 Merrins[131]	103b Whyte[132]	103a Whyte[133]	104 Bobbitt[134]
5					
5½					
6					18.0
6½					
7					18.8
7½					
8					20.3
8½					
9	24.7				21.3
9½					
10	25.2				23.0
10½					
11	27.0	24.4		24.2	25.8
11½					
12	30.4	28.1	29.5	26.4	28.4
12½					
13	33.6	31.6	35.8	29.0	31.1
13½					
14	35.1	37.0	37.3	30.4	35.1
14½					
15	45.3	43.1	42.5	34.4	41.4
15½					
16		48.3	45.0	39.9	45.5
16½					
17		49.1	46.5	43.1	46.6
17½					
18		50.8	49.5	45.9	48.9
18½					
19		50.5	52.0	48.3	51.2
19½					
20		53.2			51.6
20½					
21		54.3			51.3
22		54.3			
23					
24					
25					
26					
27					
28					

III. SCHOOL CHILDREN AND ADULTS. WEIGHT OF MALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School, well-to-do class, M 100, consecutive measurements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, M 460, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, M 60, consecutive measurements. Includes data of final norms p. 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, M 35, consecutive measurements. Not discussed in previous sections of our *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 63, 1895, U. S. naval cadets, M 4567.
7. Bib. 88, 1897, Oakland, M 1903.
8. Bib. 88, 1897, American, M 2109.
9. Bib. 95, 1911, American born Bohemian, M 523.
10. Bib. 95, 1911, American born Hungarian and Slovak, M 45.
11. Bib. 95, 1911, American born Hebrew, M 1831.
12. Bib. 95, 1911, American born Sicilian, M 153.
13. Bib. 95, 1911, American born Neopolitan, M 391.
14. Bib. 95, 1911, foreign born Bohemian, M 66.
15. Bib. 95, 1911, foreign born Hungarian and Slovak, M 34.
16. Bib. 95, 1911, foreign born Hebrew, M 533.
17. Bib. 95, 1911, foreign born Sicilian, M 204.
18. Bib. 95, 1911, foreign born Neopolitan, M 178.
19. Bib. 109, 1875, Boston, M 13,691.
20. Bib. 110, 1879, foreign.
21. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
22. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
23. Bib. 177, 1887, U. S. navy, M 4812.
24. Bib. 294, 1895, New Haven, M 50.
25. Bib. 295, 1897, Iowa, M 50.
26. Bib. 317, 1890, American, white, M and F.
27. Bib. 317, 1890, American negroes, M and F.
28. Bib. 317, 1890, Kansas City, white, M and F.
29. Bib. 317, 1890, foreign, M and F.
30. Bib. 341, 1895, Pennsylvania, M 2434.
31. Bib. 356, 1902, Amherst College, M 1321.
32. Bib. 356, 1902, Amherst College, M 2106.
33. Bib. 356, 1902, Nebraska, M 7700.
34. Bib. 356, 1902, American, M 5476.
35. Bib. 403, 1899, Italian descent.
36. Bib. 403, 1899, New York, white and negro asylum children.
37. Bib. 490, 1897-98, Washington, D. C., M 7953.
38. Bib. 580, 1881, Milwaukee, M 4773.
39. Bib. 614, 1893, St. Louis, M 16,295.
40. Bib. 615, 1894, St. Louis, M 15,325.
41. Bib. 669a, 1916, Oakland.
42. Bib. 764, 1900, Chicago, M 2788.
43. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, M 768.
44. Bib. 782, 1915, southern states, homes of good sanitary condition, M 593.
45. Bib. 873, 1896, Worcester, M and F.
46. Bib. 900, 1913, Chicago, favored class, M 218.
47. Bib. 778, 1888.
48. Bib. 229, 1914, Glasgow, poorer class.
49. Bib. 229, 1914, Glasgow, better class.

50. Bib. 281, 1883, public schools, military and naval college, M 29,405.
51. Bib. 281, 1883, all classes.
52. Bib. 427, 1918.
53. Bib. 495, 1895.
54. Bib. 663, 1878, all classes.
55. Bib. 663, 1878, soldiers, policemen, etc., M 29,531.
56. Bib. 663, 1878, artisan class, M 13,931.
57. Bib. 663, 1878, favored class, M 7709.
58. Bib. 663, 1878, Volksschulen. Taken from Ernst, Bib. 241.
59. Bib. 663, 1878, höhere Schulen. Taken from Ernst, Bib. 241.
60. Bib. 663, 1878, towns, M 2568.
61. Bib. 663, 1878, towns, M 7855.
62. Bib. 752, 1884, general population.
63. Bib. 778, 1888, laboring class.
64. Bib. 778, 1888, non-laboring class.
65. Bib. 819, 1904, London scholarship boys, M 1710.
66. Bib. 827, 1911, all England, M 261,531.
67. Bib. 827, 1911, county education areas, M 120,237.
68. Bib. 827, 1911, urban education areas, M 141,294.
69. Bib. 706, 1919, M 231.
70. Bib. 431, 1889, M 15,000.
71. Bib. 431, 1889, Volksschulen.
72. Bib. 368, 1882, Volksschulen, M 17,134.
73. Bib. 368, 1882, höhere Schulen. Taken from Ernst, Bib. 241.
74. Bib. 628, 1836, M 10 at each age.
75. Bib. 299, 1903.
76. Bib. 838, 1906, Paris, poorer class.
77. Bib. 18, 1912, Königsberg.
78. Bib. 18, 1912, Hamm.
79. 1911. Copied from Heubner,Bib. 375.
80. Bib. 191, 1884, M 700.
81. Bib. 291 and 292, 1888, Gohlis-Leipzig, Bürgerschule, M 1386.
82. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 2. Taken from Ernst, Bib. 241.
83. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 1. Taken from Ernst, Bib. 241.
84. Bib. 449, 1879, Hamburg, Gelehrtenschule. Taken from Ernst, Bib. 241.
85. Bib. 583, 1912, Pommerania, Volksschulen, city, M 14,194.
86. Bib. 583, 1912, Pommeraina, Volksschulen, country, M 28,334.
87. Bib. 583, 1912, Pommerania, Volksschulen, city and country combined, M 42,528.
88. Bib. 639, 1913, Mostar, Austria, M 545.
89. Bib. 657, 1903, Berlin, Volksschulen, M 1496.
90. Bib. 657, 1903, Berlin höhere Schulen. Taken from Ernst, Bib, 241.
91. Bib. 657, 1903, Berlin, Gymnasium, M 1740.
92. Bib. 714, 1917, poorer class, good development.
93. Bib. 714, 1917, poorer class, medium development.
94. Bib. 714, 1917, poorer class, poor development.
95. Bib. 714, 1917, well-to-do class, good development.
96. Bib. 714, 1917, well-to-do class, medium development.
97. Bib. 714, 1917, well-to-do class, poor development.
98. Bib. 723, 1901, Halle.
99. Bib. 724, 1892, Saalfeld, Bürgerschulen, M 4699.
100. Bib. 796, 1887, Radom, M 1133.
101. Bib. 241, 1906.
102. Bib. 241, 1906, Zürich, Volksschulen, M 175.
103. Bib. 204, 1889, Moscow, factory workmen. Taken from Wiazemsky, Bib. 878.

104. Bib. 210, 1883, Gymnasium. Taken from Wiazemsky, Bib. 878.
105. Bib. 238 and 239, 1888, Central Russia, M 1048.
106. Bib. 238 and 239, 1888, Moscow, M 2453.
107. Bib. 448, 1894, Warsaw, M 1540.
108. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
109. Bib. 496, 1914, Wilna, Jewish children.
110. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
111. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
112. Before 1907, cigarette makers. Taken from Wiazemsky, Bib 878.
113. Bib. 683, 1893, Gymnasium.
114. Bib. 768, 1916, Rostow, in school, M 496.
115. Bib. 768, 1916, Rostow, not in school, M 304.
116. Bib. 774, 1897, cadets. Copied from Wiazemsky, Bib. 878.
117. Bib. 865, 1911, poorer class.
118. Bib. 865, 1911, middle class.
119. Bib. 865, 1911, wealthy class.
120. Bib. 865, 1911, South Russian Jews, M 768.
121. Bib. 878, 1907, St. Petersburg cadets, M 1908.
122. Bib. 573 and 574, 1875-79, Turin, M 1048.
123. Bib. 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
124. Bib. 573 and 574, 1875-79, Turin, well-to-do class. Taken from Ernst, Bib. 241.
125. Before 1907. Taken from Wiazemsky, Bib. 878.
126. Bib. 528, 1909, M and F 869,014.
127. Bib. 528, 1909, M 9606.
128. Bib. 528, 1909.
129. Bib. 529, 1893, M 1250.
130. Bib. 103, 1909, M 60.
131. Bib. 519, 1910, students, M 219.
132. Bib. 876, 1918, Pekin, M 1502.
133. Bib. 876, 1918, southern provinces, M 1357.
134. Bib. 103, 1909, M 1180.

WEIGHT OF FEMALES IN KILOGRAMS

	American										
Age in Years	1b Baldwin[1]	1a Baldwin[2]	2a Baldwin[3]	2b Baldwin[4]	3 Barnes[5]	5a Boas[6]	6 Boas[7]	9 Bowditch[8]	11a Bowditch[9]	11b Bowditch[10]	14 Gilbert[11]
5		17.2	17.2					18.0			
5½		18.2	18.5								
6	19.8	18.9	19.3		20.8	19.9	20.7	19.6			18.9
6½	21.2	20.1	20.8								
7	21.9	21.8	21.3	22.7	21.8	21.7	22.5	21.6			21.5
7½	22.2	22.9	23.2	24.2							
8	23.3	24.8	24.4	23.7	23.7	23.5	25.3	23.6			23.1
8½	25.2	25.9	26.0	24.4					23.5	23.9	
9	26.4	26.1	26.8	26.5	26.6	26.3	27.2	25.9			26.4
9½	26.9	27.9	29.2	28.4					25.7	26.7	
10	29.7	29.4	30.0	30.2	28.7	29.1	30.3	28.3			28.2
10½	29.8	31.0	32.7	31.8					28.1	28.9	
11	30.3	32.5	33.2	33.8	31.6	31.8	33.7	31.2			31.4
11½	32.9	34.0	36.9	35.8					30.8	32.0	
12	34.2	37.6	38.1	38.6	35.8	36.7	38.2	35.5			36.2
12½	37.7	41.5	42.4	41.5					35.2	36.4	
13	43.0	41.6	44.5	44.5	41.1	40.7	42.7	40.2			42.7
13½	43.1	43.7	47.6	46.9					39.7	41.4	
14	46.5	46.4	49.1	49.1	44.5	45.6	48.0	44.6			45.3
14½	47.0	48.0	51.7	50.9					44.4	45.1	
15	50.8	50.0	51.5	52.7	49.4	48.2	50.2	48.1			50.5
15½	50.4	52.3	52.7	53.9					47.7	48.8	
16	49.4	51.5	54.0	56.1	49.8	49.3	52.9	50.8			50.6
16½	51.0	53.0	54.6	56.5						50.4	
17	51.4	53.5	54.7	56.8	53.4	52.0	53.3	52.4			54.9
17½	52.9	54.0	56.0	56.4							
18	52.5	53.1	54.2	56.6	53.7			52.3			56.9
18½			55.4	57.4							
19											57.3
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											
29											

WEIGHT OF FEMALES IN KILOGRAMS

Age in Years	American									
	13 Gilbert[12]	15a Greenwood[13]	15b Greenwood[14]	16c Greenwood[15]	16a Greenwood[16]	18a Hanna[17]	18b Hanna[18]	20 Hastings[19]	23a Hrdlička[20]	23d Hrdlička[21]
5								17.3		15.4
5½										
6	20.1							18.5	17.7	18.1
6½										
7	22.9							20.7	18.7	19.1
7½										
8	24.0							22.1	19.5	20.4
8½										
9	26.7							24.8	23.1	23.6
9½										
10	28.4							27.1	26.1	27.2
10½										
11	31.8	29.0	29.1	29.9	28.9			28.9	29.6	29.5
11½										
12	38.3	32.0	35.8	30.0	32.0			33.0	32.7	32.7
12½										
13	41.7	35.5	40.8	36.6	39.3			37.9	35.8	38.1
13½										
14	44.5	40.9	44.9	41.6	45.4			42.8	46.3	44.0
14½										
15	47.2	45.9	46.1	45.4	47.5			46.6		50.8
15½						39.7	39.4			
16	51.3	48.6	48.7	50.4	50.0	38.0		50.3		51.7
16½						41.5	40.5			
17	51.6			53.1		45.0	42.9	50.3		
17½						43.7	44.3			
18				53.9		46.1	45.5	50.1		47.2
18½						47.3	47.3			
19				54.5		48.3	48.1	51.3		
19½						50.0	50.0			
20						51.7	51.0	52.2		
20½						52.7	52.7			
21						54.4	53.5			
22						56.8	55.8			
23										
24						59.8				
25										
26										
27						64.4				
28						**	**			

WEIGHT OF FEMALES IN KILOGRAMS

Age in Years	American										American and English
	24a Macdonald[22]	25 Peckham[23]	27 Porter[24]	28 Porter[25]	29 Robertson[26]	30 Smedley[27]	33a Stiles and Wheeler[28]	33b Stiles and Wheeler[29]	34 West[30]	35 Young[31]	37 Stephenson[32]
5	19.6	18.1							17.9		18.0
5½											
6	20.7	19.6	18.9	18.9	20.1	18.9	20.4	20.4	19.8	18.6	19.4
6½						19.9					
7	22.4	21.3	20.8	20.8	22.4	21.0	22.3	22.2	21.8	21.1	21.4
7½						22.0					
8	24.4	23.1	22.9	22.9	24.3	23.0	23.9	24.2	23.4	24.6	23.6
8½						24.0					
9	26.5	25.6	25.1	25.1	27.1	25.3	26.4	26.5	26.0	30.1	25.5
9½						26.5					
10	29.1	28.3	27.5	27.5	30.0	27.8	29.0	29.2	28.8	30.7	28.2
10½						29.1					
11	33.2	31.2	30.2	30.2	34.1	30.7	32.3	32.0	31.7	34.7	31.1
11½						32.3					
12	37.1	35.3	33.7	33.7	36.6	34.4	38.2	37.4	36.2	38.3	35.1
12½						36.5					
13	42.2	39.9	38.5	38.5	44.1	39.0	43.4	43.8	39.8	38.5	39.8
13½						44.2					
14	45.5	44.3	42.3	42.3	47.9	44.2	44.8	44.6	45.0	46.1	44.3
14½						47.0					
15	47.7	48.0	46.7	46.7		48.2	49.4	49.3	47.6	51.4	47.8
15½						49.4					
16	49.9	50.2	50.3	50.3		50.7	50.8	51.0	49.4	49.7	51.0
16½						52.0					
17	50.6	51.4	52.6	52.6		52.4	52.4	52.8	52.2	56.9	52.3
17½						52.8					
18		51.0	52.4	52.4		52.9			54.4	50.9	52.8
18½						53.1					
19			52.2	52.2					53.7		
19½											
20			53.9	53.9					54.3		
20½											
21											
22											
23											

WEIGHT OF FEMALES IN KILOGRAMS

	English										Norwegian
Age in Years	38 Berry[33]	39a Elderton[34]	39b Elderton[35]	41 Galton[36]	42 Kerr[37]	44a Roberts[38]	45 Shuttleworth[39]	49a Tuxford & Glegg[40]	49b Tuxford & Glegg[41]	49c Tuxford & Glegg[42]	50 Schiötz[43]
5				17.8		18.0	17.8	17.1	17.2	16.9	
5½											
6		18.1	19.0	18.9	20.5	19.2	18.9	18.6	18.7	18.4	
6½											
7		19.5	20.7	21.6	22.9	21.2	21.6	20.5	20.6	20.4	
7½											
8		21.1	22.4	23.6	25.4	23.7	23.6	22.2	22.2	22.2	
8½											
9		22.9	24.6	25.2	27.4	25.2	25.2	24.8	25.1	24.6	
9½											
10		24.8	26.7	28.1	30.0	28.1	28.5	26.7	26.9	26.6	
10½											
11	31.8	27.0	29.2	30.8	33.8	30.9	30.9	29.6	30.3	29.2	
11½											
12	34.0	29.6	32.0	34.7	38.7	34.7	34.7	33.5	33.8	32.8	35.3
12½											
13	38.1	32.8	35.7	39.6	44.1	39.5	39.6	36.3	36.8	35.9	38.6
13½											
14	44.9	34.8	40.4	43.9	48.0	43.9	43.9	39.8	40.1	39.7	44.4
14½											
15	48.1			48.1	51.2	47.5	48.2				47.8
15½											
16				51.3	52.4	51.1	51.3				50.6
16½											
17				52.2	52.8	52.1	52.4				52.3
18				54.9		53.4	54.9				
19				56.2		56.1	56.2				
20				56.0		55.9	56.0				
21				55.2		55.0	55.2				
22						56.3	56.0				
23						57.3	56.3				
24						54.7	54.8				
25						**	**				

WEIGHT OF FEMALES IN KILOGRAMS

	Swedish		Danish			Belgian	French	German			
Age in Years	52a Key[44]	52b Key[45]	53a Hertel[46]	53b Hertel[47]	54 Vahl[48]	55 Quetelet[49]	58 Variot & Chaumet[50]	59a Ascher[51]	59b Ascher[52]	60 Camerer[53]	64 Geissler[54]
5					17.9	15.3				17.5	
5½							15.2				
6					18.9	16.7				19.0	20.5
6½	20.7	20.6	20.0				17.4	19.4	19.1		
7					22.0	17.8				20.7	22.4
7½	21.6	22.2	21.5				19.0	20.6	21.3		
8					24.3	19.0				22.5	24.5
8½	25.0	23.2	23.5				21.2	24.0	23.5		
9					26.8	21.0				24.9	26.2
9½	26.9	25.5	25.5				23.9	25.8	25.0		
10					29.4	23.0				26.4	28.5
10½	29.4	28.0	28.0				26.6	27.3	27.8		
11					33.6	25.5				29.1	31.6
11½	31.9	30.5	30.5	31.0			29.0	29.1	31.2		
12					36.6	29.0				33.7	35.3
12½	35.9	33.9	34.0	34.0			33.8	33.8	35.3		
13					40.7	32.5				37.9	38.6
13½	39.6	37.7	38.0	38.5			38.3	38.2	38.5		
14					46.0	36.3				42.6	
14½	44.8	41.3	42.0	43.5			43.2				
15					49.3	40.0				47.2	
15½	48.9	46.0	46.5	46.5			46.0				
16					45.8	43.5				48.2	
16½	51.6		51.0	51.0							
17						46.8				49.2	
17½	54.6										
18						49.8				50.0	
18½	56.3										
19						52.1					
19½	57.4										
20						53.2					
20½	57.7										
21											

WEIGHT OF FEMALES IN KILOGRAMS

	German								Swiss		Russian
Age in Years	66b Hasse[53]	66a Hasse[56]	70 Radosavljevich[57]	73b Rietz[58]	73a Rietz[59]	73c Rietz[60]	76 Schmid-Monnard[61]	77a Schmidt[62]	82 Ernst[63]	81 Ernst[64]	85a Diek[65]
5							15.6				
5½											
6			19.2	19.6	22.3		18.5	18.2			
6½											
7			20.5	21.6	23.7		19.2	20.3			
7½											
8			23.6	23.3	26.1		21.4	22.0			
8½	23.8	24.6				26.1			22.1	23.8	
9			25.3	24.6	27.7		23.5	24.4			
9½	25.8	27.1				27.8			22.3	24.4	
10			27.6	27.5	30.5		25.3	26.6			
10½	28.2	28.5				32.1			23.9	30.2	23.9
11			30.2	30.2	34.4		28.4	29.5			
11½	31.0	32.7				34.4			24.5	31.3	25.3
12			34.9	34.3	37.9		31.8	32.7			
12½	34.7	36.5				40.5			25.0	32.4	31.0
13			39.1	39.2	41.5		36.2	36.6			
13½	38.0	40.2				43.1			26.5	39.0	33.2
14			44.9	43.0	46.0		40.8				
14½	42.2	44.4				49.7	**		26.8	41.3	41.3
15			48.1		51.6						
15½						51.2					42.6
16					56.2						
16½											45.3
17					59.0						
17½											45.8
18					64.3						
18½											
19					65.4						
19½											
20											
20½											
21											

WEIGHT OF FEMALES IN KILOGRAMS

	Russian								Italian		
Age in Years	85b Diek[66]	86a Erismann[67]	87a Kosmowski[68]	87b Kosmowski[69]	89a Michailoff[70]	89b Michailoff[71]	90a Mouratow[72]	90b Mouratow[73]	96a Pagliani[74]	96b Pagliani[75]	96c Pagliani[76]
5									15.0		
5½											
6		19.4							16.4		
6½											
7		21.3							17.7		
7½				18.9							
8		22.0							19.0		
8½			21.0	21.0	21.3	21.3				22.8	18.5
9		25.6							21.9		
9½			22.3	22.3	23.2	22.0				25.1	20.9
10		27.4							24.7		
10½	29.4		24.7	24.7	25.0	25.6				27.3	23.4
11		30.3							26.9		
11½	31.0		26.9	26.9	27.1	27.3	29.3	21.7		28.5	26.0
12		36.5							29.5		
12½	35.2		30.6	30.6	28.9	30.3	30.9	21.2		31.8	28.5
13		40.5							34.5		
13½	39.2		32.2	32.2	31.9	36.5	33.7	37.7		37.6	31.4
14		42.8							38.5		
14½	44.8		38.1	38.1		40.5	37.7	36.9		43.0	32.9
15		45.3							43.8		
15½	46.6					42.6	38.8	42.8		45.6	36.9
16		45.8							45.7		
16½	48.1						45.0	47.2		45.7	
17									47.5		
17½	49.8						47.6	51.4			
18									48.6		
18½	51.2						51.4	52.2			
19											
19½											
20											
20½											
21											
22											
23											
24											
25											
26											
27											
28											

WEIGHT OF FEMALES IN KILOGRAMS

	Italian	Japanese			Chinese		Philippine
Age in Years	97 Vitale-Vitali[77]	98 Misawa[78]	99a Misawa[79]	100 Miwa[80]	102 Merrins[81]	103a Whyte[82]	104 Bobbitt[83]
5			14.5	15.6			
5½							
6			16.0	16.8			
6½							
7		16.7	17.2	17.9			18.6
7½							
8		18.7	18.7	19.6			20.3
8½							
9		20.0	20.5	21.8			22.8
9½							
10		21.9	22.3	23.8			23.2
10½	24.6						
11		24.5	24.4	26.1		26.1	26.5
11½	25.1						
12		26.8	27.8	30.0	25.9	28.7	29.8
12½	28.0						
13		30.1	31.4	33.3	32.9	32.8	33.5
13½	31.0						
14		33.5	36.5	38.8	37.4	34.5	36.5
14½	32.6						
15		36.4	38.2	41.2	41.1	39.2	40.0
15½	34.0						
16		39.7		42.3	45.2	40.7	41.6
16½	35.6						
17				45.2	46.7	42.9	43.4
17½	35.7						
18				45.7		46.2	44.0
18½	35.8						
19				45.1	47.2	44.7	42.8
19½	34.2					**	
20				46.0			42.5
20½							
21					52.6		
22							
23							
24							
25							
26							
27							

III. SCHOOL CHILDREN AND ADULTS. WEIGHT OF FEMALES

1. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School, well-to-do class, F 638, consecutive measursements.
2. Bib. 27, 1914, Chicago: University of Chicago Schools and Francis W. Parker School. New York: Horace Mann School, well-to-do class, F 100, consecutive measurements.
3. 1920, New York: Horace Mann School, well-to-do class, F 60, consecutive measurements. Includes data of final norms, p. 152.
4. 1920, Chicago: Francis W. Parker School, well-to-do class, F 47, consecutive measurements. Not discussed in previous sections of this *Study*.
5. Bib. 35, 1892, Oakland, M and F 4956.
6. Bib. 88, 1897, American, F 1716.
7. Bib. 88, 1897, Oakland, F 2304.
8. Bib. 109, 1875, Boston, F 10,904.
9. Bib. 110, 1879, Boston laboring class. Taken from Ernst, Bib. 241.
10. Bib. 110, 1879, Boston non-laboring class. Taken from Ernst, Bib. 241.
11. Bib. 295, 1897, Iowa, F 50.
12. Bib. 294, 1895, New Haven, F 50.
13. Bib. 317, 1890, American white, M and F 743.
14. Bib. 317, 1890, American negro, M and F 723.
15. Bib. 317, 1890, Kansas City white, M and F 2055.
16. Bib. 317, 1890, Foreign descent, M and F 385.
17. Bib. 345, 1893, Oberlin College, M and F 500.
18. Bib. 345, 1893, Oberlin College, M and F 1600.
19. Bib. 356, 1902, Nebraska, F 7069.
20. Bib. 403, 1899, Italian descent.
21. Bib. 403, 1899, New York, white and negro asylum children.
22. Bib. 490, 1897-98, Washington, D. C., F 8520.
23. Bib. 580, 1881, Milwaukee, F 4891.
24. Bib. 614, 1893, St. Louis, F 18,059.
25. Bib. 615, 1894, St. Louis, F 16,112.
26. Bib. 6699, 1916, Oakland.
27. Bib. 764, 1900, Chicago, F 3471.
28. Bib. 782, 1915, southern states, homes of good and poor sanitary condition, F 877.
29. Bib. 782, 1915, southern states, homes of good sanitary condition, F 662.
30. Bib. 873, 1896, Worcester, M and F 2350.
31. Bib. 900, 1913, Chicago, favored class, F 144.
32. Bib. 778, 1888.
33. Bib. 58, 1904, London, scholarship girls, F 1384.
34. Bib. 229, 1914, Glasgow, poorer class.
35. Bib. 229, 1914, Glasgow, better class.
36. Bib. 281, 1883, all classes.
37. Bib. 427, 1918.
38. Bib. 663, 1878, all classes.
39. Bib. 752, 1884, general population.
40. Bib. 827, 1911, all England, F 258,834.
41. Bib. 827, 1911, county education areas, F 121,648.
42. Bib. 827, 1911, urban education areas, F 137,186.
43. Bib. 706, 1919, F 177.
44. Bib. 431, 1889, Mittelschulen.
45. Bib. 431, 1889, Volksschulen.
46. Bib. 368, 1882, Volksschulen, F 11,250.
47. Bib. 368, 1882, höhere Schulen. Taken from Ernst, Bib. 241.
48. Bib. 832, 1884.

49. Bib. 628, 1836, F 10 at each age.
50. Bib. 838, 1906, Paris, poorer class.
51. Bib. 18, 1912, Hamm.
52. Bib. 18, 1912, Königsberg.
53. 1911. Taken from Heubner, Bib. 375.
54. Bib. 291 and 292, 1888, Gohlis-Leipzig, F 1420.
55. Bib. 353, 1891, Gohlis-Leipzig Bürgerschule 1. Taken from Ernst, Bib. 241.
56. Bib. 353, 1891, Gohlis-Leipzig, Bürgerschule 2. Taken from Ernst, Bib. 241.
57. Bib. 639, 1913, Mostar, Austria, F 615.
58. Bib. 657, 1903, Berlin Volksschulen, F 1365.
59. Bib. 657, 1903, Berlin Gymnasium, F 533.
60. Bib. 657, 1903, Berlin höhere Schulen. Taken from Ernst, Bib. 241.
61. Bib. 723, 1901, Halle, F 1177.
62. Bib. 724, 1892, Saalfeld Bürgerschulen, F 4807.
63. Bib. 241, 1906.
64. Bib. 241, 1906, Zürich Volksschulen, F 175.
65. Bib. 210, 1883, schools and asylums. Taken from Wiazemsky, Bib. 878.
66. Bib. 210, 1883, institutions. Taken from Wiazemsky, Bib. 878.
67. Bib. 238 and 239, 1888, Moscow, F 1495.
68. Bib. 448, 1894, Ferien-Kolonien. Taken from Ernst, Bib. 241.
69. Bib. 448, 1894, Warsaw, F 1898.
70. Bib. 523, 1887, Dorfschulen. Taken from Ernst, Bib. 241.
71. Bib. 523, 1887, Stadtschulen. Taken from Ernst, Bib. 241.
72. Before 1907, cigarette makers, city. Taken from Wiazemsky, Bib. 878.
73. Before 1907, cigarette makers, country. Taken from Wiazemsky, Bib. 878.
74. Bib. 573 and 574, 1875-79, Turin, F 968.
75. Bib 573 and 574, 1875-79, Turin, favored class. Taken from Ernst, Bib. 241.
76. Bib. 573 and 574, 1875-79, Turin, asylum children. Taken from Ernst, Bib. 241.
77. Before 1907. Taken from Wiazemsky, Bib. 878.
78. Bib. 528, 1909, M and F 869,014.
79. Bib. 528, 1909, F 7466.
80. Bib. 529, 1893, F 2800.
81. Bib. 519, 1910, students, F 69.
82. Bib. 876, 1918, south provinces, F 613.
83. Bib. 103, 1909, F 428.

PART VI

CHAPTER XI

ANNOTATED BIBLIOGRAPHY
(911 Titles)

*1. Ahlfeldt,— *Ernährung des Säuglings an der Mutterbrust.* Leipzig: 1878.
Reports weight of three infants.

2. Aitken, W. *On the Growth of the Recruit and the Young Soldier.* London: 1862. pp. 72.
A preliminary study of the British soldier.

3. Albert, J. and Arvizú, T. Physico-Mental Development of Filipino Children. *Actas. mem. y comun. de la 3 Assembl. reg. de med. y. farm. de Filipinos,* Manila: 1917, 421-432.

4. Alfeyeff, I. Y. (Correlations of Weight, Height and Chest Measurements in Man) *Voyenno-Med. J.,* 1912, (233), med.-spec. pt., 503-540. Russian.

5. Allaria, G. B. Richerche anthropometriche sulla crescenza della fanciulle povere. *Ramazzini,* 1912, (6), 60-86.

*6. Altherr,— *Über regelmässige tägliche Wägungen der Neugeborenen.* Diss. Basel: 1874.

7. Ammon, O. Anthropologische Untersuchungen der Wehrpflichtigen in Baden. *Virschow-Holzendorf's Samml. gemeinverständl. wissenschaftl. Vorträge,* 1890, Part 101.

8. Ammon, O. Die Körpergrösse der Wehrflichtigen im Grossherzogtum Baden in den Jahren 1840-1864. *Beiträge zur Statistik des Grossherzogtum Baden,* 1894, n. f. Part 5.

9. Angerstein, W. *Die Massverhältnisse des menschlichen Körpers und das Wachstum der Knaben.* Köln: 1865. Pp. 10.

10. Anonymous Pignet's Standard and Chinese Students. *Boston Med. and Surg. J.,* 1916, (194), 329-330.
A brief editorial reporting the work of Firth on East Indians and of Black on Chinese, revealing the poor physical condition of these peoples. No tables.

11. Anonymous A Physical Census (in England) and its Lesson. *Brit. Med. J.,* 1918, 348-349.
Results of the physical examination of drafted men for the first eight months of 1918 show that only 36 to 37 per cent were placed in class A.

12. Anonymous *J. Amer. Med. Ass'n.,* 1920, (74), 329.
Editorial comment on an article by Pfaundler (Über Körpermasse von Münchener Schulkindern während des Krieges. *Münch. med. Woch.,* Aug. 1, 1919, No. 31, 859). Pfaundler showed that boys and girls grew less during the war years and that the average decrease in gains was more conspicuous in children of professional classes than in those of less well-to-do classes. War acted as a leveller of classes from the somatic as well as from other standpoints.

13. Anthony,— Études anthropométriques sur la taille, le perimétre thoracique et le pois des hommes de 20 à 25 ans. *Atti d. 11 Cong. med. internaz.* 1884, (6), chir. e. med. Mil. 81.

This study shows the decreasing increments of growth in adults.

14. ANUTSCHIN,— (On the Geographical Distribution of the Male Population of Russia in Respect of Height). *Trans. Imperial Geog. Soc.*, (7), part 1.
Russian, cited by Sack.

15. ARKLE, A. S. The Correlation of Physical and Mental Development. *J. Roy. Inst. Pub. Health*, London: 1908, (16), 741-748.

16. ARON, H. Untersuchungen über die Beeinflussung des Wachstums durch die Ernährung. *Berl. klin. Woch.*, 1914, (51), No. 21, 972-977.
The experimenter fed animals on various sorts of inadequate diets and compared the resulting curves for increase of height and weight with curves for infants that had been similarly handicapped in growth. The height curves showed in both cases a closer approximation to normal than did the weight curves. After interruption due to malnutrition the curve usually rose again but normal full growth was unlikely to occur.

17. ARTHAUD, G. Estudio sobre la curva de crecimiento y sobre las variaciones del peso del hombre. Transl. *Gac. méd catal.*, 1885, (18), 478-481. Also (in French) *Progrès méd.*, 1893, 2 s. (18), 397-400.

18. ASCHER,— Über Schülerfürsorge. *Zsch. f. Medizinalbeamte*, 1912, (25), 79-89.
For this investigation 14,000 children of Königsberg and 7087 children of Hamm were measured. The article gives a table of weights for each one centimeter increase in height.

*19. ASTENGO, A. *Rapport du poids des enfants à la durée de la grossesse.* Paris: 1905. Pp. 48.
A study of length of pregnancy as it affects weight.

20. AUBOYER, L. *De la croissance et de ses rapports avec les maladies aiguës fébriles de l'enfance et de l'adolescence.* Thesis, Lyon: 1881.

21. AUDRAN, G. *Les proportions du corps humain mesurées sur les belles figures de l'antiquité.* Paris: 1683. Pp. 26.
An elaborate study with diagrams and measurements of twenty-five famous statues.

*22. AUSSET,— Les stagnations de poids chez les enfants et particulièrement chez les nourrissons. *Bull soc. de pédiat. de Paris*, 1904 (6), 193-209.

23. BACHAUER,— AND LAMPERT,— Vorschläge zur einheitlicher Organization der Kinderwägungen und-messungen. *Zsch. f. Schulgesundheitspf.*, 1919, (32), 97-109.
Some considerations of importance in the technique of measurement.

24. BALDWIN, B. T. Individual Differences in the Correlations of Physical Growth of Elementary and High School Pupils. *J. of Ed. Psychol.*, 1911, (2), 150-152.
Abstract. A preliminary report of the beginnings of the investigation included in *Physical Growth and School Progress.*

25. BALDWIN, B. T. *Notes on School Observation. The Physical Nature of the Child.* (Univ. of Texas Bull. No. 188), 1911. Pp. 26.
This is a general outline designed as a guide to teachers in observing the grosser physical defects, with charts and tables on physical growth.

26. BALDWIN, B. T. A Psycho-Educational Study of the Fourth and Fifth School Grades. *J. of Educ. Psychol.*, 1914, (4), 364-365.

A short report of a longer study of the interrelations between chronological, physiological and pedagogical age. Taller and heavier boys and girls, who are also the younger of the two groups, mature earlier and complete the elementary school work at an earlier age and with a higher average mark than do the short light or physiologically retarded boys and girls.

27. BALDWIN, B. T. *Physical Growth and School Progress.* Washington: U. S. Bur. of Educ., 1914, No. 10. Pp. 212.

This is an extensive series of measurements at yearly and half yearly intervals of 861 boys and 1063 girls in elementary and high schools of Chicago and New York City. The records include consecutive measurements on the same individuals (nude) for periods of three to 12 years, of height, weight and lung capacity, together with the school marks of these same children from grade to grade. The data are carefully analyzed in 34 tables and 39 charts, which show that these children are on the average better developed physically than those measured for the norms of other investigators. The conclusion is drawn that "if pedagogical age is accepted as a fair equivalent in these three different schools, for mental development, the tall heavy boys and girls, with good lung capacity, are older physiologically and further along in their stages toward mental maturity as evidenced by school progress, than the short light boys and girls."

28. BALDWIN, B. T. A Measuring Scale for Physical Growth and Physiological Age. *Fifteenth Yearbook of the Nat. Soc. for the Study of Educ.* Bloomington, Ill.: Pub. Sch. Pub. Co., 1916, Part 1, 11-23.

The material and charts in this article are supplementary to a previous study *Physical Growth and School Progress.* Score cards are presented for boys and girls 5½-17½ years, giving the Baldwin and the Boas norms for height, weight and lung capacity, with graphs on which the child's development can be plotted for comparison with these norms. A chart with growth curves for height, of eight girls, measured over an extended period is given, showing the time of appearance of menstruation. These curves show that tall girls as a rule mature earlier than shorter ones. A distribution table of pubescent changes in 1241 girls is given. Another chart shows the distribution of pre-pubescent and post-pubescent boys (1317 from the city, 3600 from the country). From this it appears that the pubescent changes occur earlier in country boys.

29. BALDWIN, B. T. *The Physical Growth of School Children.* (Univ. of Iowa Extens. Bull. No. 59) Iowa City, Iowa: Univ. of Iowa, 1919.

Describes the Iowa Plan of making and recording measurements and gives norms and score cards developed by Baldwin.

30. BALDWIN, B. T. *Experimental Studies in Education.* Baltimore: Johns Hopkins University, 1920. Pp. 80.

Contains correlations of psycho-educational with physical measurements from the Johns Hopkins Demonstration School.

*31. BAMBERG, K. Zur Frage der Rohmilchernährung. *Jahrb. f. Kinderheilk.*, 1913, (71), 670-682.

This article is mostly concerned with the nutrition of infants. It contains a number of individual growth curves (some for almost a year) with notes on feeding.

32. BARDEEN, C. R. *The Height-Weight Index of Build in Relation to Linear and Volumetric Proportions and Surface-Area of the Body During Post-Natal Development.* (Wisconsin Contrib. to

Embryology, No. 46. Extracted from Public. 272, Carnegie Instit. of Washington, 483-554.) Madison: Univ. of Wisconsin. No date, about 1918.

This monograph presents a study of the height-weight ratio as an index of the proportions of the human body for purposes of coördinating investigations in gross anatomy. Eleven charts and twenty-eight tables selected from original data by Boas, Baldwin, Hastings, Quetelet and others, are included. The original contributions are primarily the growth height-weight index norms and the adaptation of formulae for correlating bodily surface and bodily volume. A short list of references is attached.

33. BARDEEN, C. R. *Height-Weight Chart for School Boys.* (Bull. of the Univ. of Wisconsin) Madison: Univ. of Wisconsin, Feb., 1920.

This is a chart constructed from data from many sources. Vertical lines represent weight in pounds and horizontal lines stature in inches. Oblique black lines are drawn to represent a series of boys of the same age, but varying in height and weight, while oblique red lines represent determined indices of build. The index of build corresponding to relative bulk is obtained by dividing the weight in pounds by the cube of the stature in inches and multiplying the quotient by 1,000. The chart can be used for individual diagnosis by plotting directly upon the graph the measurements of any child between the ages of three and twenty.

34. BARDEEN, C. R. *Height-Weight Chart for School Girls.* (Bull. of the Univ. of Wisconsin) Madison: Univ. of Wisconsin, Feb., 1920.

Similar in construction to the chart for boys.

35. BARNES, E. Physical Development of Oakland Children. *Oakland Sch. Rep.*, 1892-93, (93), 38-44.

A study of the physical development of about 6000 Oakland school children, with charts and tables showing height, weight, and age and the occupations and nationalities of the children. The children from Oakland were heavier and taller than the children from Boston, Worcester, Toronto, St. Louis, and Milwaukee, whose records were displayed at the World's Fair in Chicago in 1892.

36. BARR, ANNE L. Some Anthropometric Data of Western College Girls. University of Nebraska. *Am. Phys. Educ. Rev.*, 1903, (8), 245-248.

A brief discussion of the effect of environment in producing good physical development.

37. BARTUCZ, L. Die Körpergrösse der heutigen Magyaren. *Arch. f. Anthropol.*, n. f., 1916, (15), 44-59.

*38. BAUDRAND, M. *L'accroissement;* ses caractères normaux et anormaux chez le nourrisson: ses rapports avec l'hérédité, plus spécialement dans les états morbides (syphilis, alcolisme et tuberculose). Paris: Doin et fils, 1911. Pp. 648.

The title is explanatory of the contents of this important book, which contains many graphs, showing the growth of infants under these conditions.

39. BAXTER, J. H. *Statistics, Medical and Anthropological, of the Provost General's Bureau.* Washington: 1875, (1).

This is an important comparative study showing that the size of adult Americans is very different in different states of the Union, and even in different parts of the same state. There is apparently an influence of climate upon growth.

40. BAYERTHAL,— Kopfgrösse und Intelligenz im Schulpflichtigen

Alter. *Zschr. f. exper. Pädag.*, 1910, (10), Heft 2-3, 197-218. See also 1905, (2), 247-251; 1906, (3) 238-242; 1907, (5) 223-228.

Measurements are given of the head circumference of several thousand school children who were also rated in five grades by their teacher or by the investigator, as regards intellectual ability. These ratings were made presumably on the basis of excellence in reasoning, rather than mere memorizing. The conclusion is drawn that large-headedness is directly correlated with intelligence, and can be used for diagnostic purposes. In view of the coarseness of the intellectual grading and the extreme subjectivity of this rating, the statistics are of doubtful value.

41. Bean, R. B. A Preliminary Report on the Measurements of About 1000 Students at Ann Arbor, Mich. *Anat. Rec.*, 1907, (1), 67-68. Appears in *Amer. J. Anat.*, 1907-08, (6).

Measurements were made of 910 boys and 116 girls of the freshman class. No tables are given, but the results are used for a discussion of racial types.

42. Bean, R. B. The Stature and the Eruption of the Permanent Teeth of American, German-American, and Filipino Children. *Amer. J. Anat.*, 1914, (17), 113-160.

Data on 776 Filipino, 628 German and 812 American boys and girls. No age curves are given for stature. Filipinos mature earlier in stature and eruption of teeth.

43. Bean, R. B. The Growth of the Head and Face in American (white), German-American and Filipino Children. *Anat. Record*, 1915, (9), 50-52.

This is an abstract of an address and therefore has no tables. In general, American children show the greatest growth with respect to these measurements, next German, and last Filipino children.

44. Beddoe,— On the Physical Characteristics of the Jews. *Trans. of the Ethnol.* Soc., London: 1861, (1), 223.

A study included primarily for its historical significance.

45. Beddoe,— On the Stature and Bulk of Man in the British Isles. *Memoirs of the Anthropol. Soc.*, London: 1870, (3), 545.

A pioneer study of physical development.

46. Beik, A. K. Physiological Age and School Entrance. *Ped. Sem.*, 1913, (20), 277-321.

A general discussion without tables, pointing to the conclusion that physiological development should have advanced sufficiently before children should be admitted to school. Five pages of references.

47. Belaiew,— (*Matériales pour l'étude sanitaire des indigents du g. de Simbirsk.*) Diss. St. Petersburg: 1886. Russian, cited by Wiazemsky.

Materials for the health study of the poor of Simbirsk.

48. Belyaieff,— (*Materials for Investigating the Influence of Schools on the Physical Development of Pupils.*) Diss., St. Petersburg: 1888. Russian, cited by Sack.

49. Benders, A. M. De Toeneming der lichaamslengte van de mannelijke bevolking in Nederland. *Nederl. Tijdschr. v. Geneesk.*, 1916, (1), 1438-1449.

50. Benedict, F. G. A Photographic Method for Measuring the Surface of the Human Body. *Amer. J. of Physiol.*, 1916, (41), 275.

The method is new and suggestive.

*51. Benestad, G. Die Gewichtsverhältnisse reifer norwegischer Neuge-

borener in den ersten 12 Tagen nach der Geburt. *Arch. f. Gynäk.*, 1913, (101), 292-350.

A careful analysis of data from 1,979 infants with a bibliography of 46 titles. Many tables and graphs.

*52. BENESTAD, G. Wo liegt die Ursache zur physiologischen Gewichtsabnahme Neugeborener? *Jahrb. f. Kinderheilk.*, 1914, (80), 21-41.

A good review of the literature with references. Benestad believes the loss to be due to an insufficiency in the total metabolism.

*53. v. d. BERGH, A. A. H. Over voeding en voedingsstoornissen in het eerste levensjaar. *Geneesk. Bl. u. Klin. en. Lab. v. de prakt.*, 1893, (5), 51-86.

*54. BERGMANN, E. Die physiologische Gewichtsabnahme und die Beziehung zwischen Ernährung und Gewichtsverlauf bei 1000 Neugeborenen. *Zsch. f. Kinderheilk.*, 1916, (14), 149-165.

The writer found that 21.7% of these infants reached the birth weight by the end of the second week, 15.3% more reached it by the end of the third week, 24.1% more by the end of the fourth week.

55. BERGMÜLLER, J. G. *Geometrischer Maasstab der Säulenordnung und Anthropometria, oder Natur des Menschen.* Augsburg: 1723.

56. BERLINER, M. Über die Beziehung des proportionellen Brustumfanges zum Index der Körperfülle bei männlichen Individuen im Wachstumsalter. *Berl. klin. Woch.*, 1920, (57), 33-34.

An investigation of 60 boys 10-18 years of age in a clinic showed that with increased chest circumference there was an increase in the "Index der Körperfülle."

57. BERLINERBLAU, M. (*The Physical Development of the Children in an Orphan Asylum.*) Moskau: 1908. Russian.

58. BERRY, F. M. D. On the Physical Examination of 1580 Girls from the Elementary Schools in London. *Brit. Med. J.*, 1904, Part 1, 1248-1249.

These are measurements on girls who held scholarships. Table of height and weight is given for ages 11 to 15. (For similar data on scholarship boys see Thorne).

59. BERTILLON, A. Les proportions du corps humain. *Rev. scient.*, 1889, (43), 524-529.

An important anthropometric contribution for recording comparative measurements of individuals.

60. BERTILLON, A. *Signaletic Instructions; Including the Theory and Practice of Anthropometrical Identification.* Chicago and New York; 1896. Pp. 260.

61. BEYER, H. G. Observations on Normal Growth and Development under Systematized Exercises. *Rep. of Chief of Bur. of Med. and Surg. to the Sec. of the Navy.* Washington: 1893, 149-160.

62. BEYER, H. G. The Application of the Mean Values Derived from a Large Number of Measurements to the Annual Physical Examination of Cadets of the Naval Academy. *Rep. Sug. Gen. Navy,* 1894, 105-110.

63. BEYER, H. G. Growth of the United States Naval Cadets. *Proc. of the U. S. Naval Inst.*, 1895, (21), 297-333.

A simple presentation of methods of computing physical measurements, the application of percentile grades, and a series of 48 tables.

64. BEYER, H. G. The Influence of Exercise on Growth. *Amer. Phys. Educ. Rev.*, 1896, (1), 76-87.
Also in *J. of Exper. Med.*, 1896, (1), No. 3.
Averages obtained from a group of applicants for admission to a military training academy are compared with the averages of men who have had this military training. Comparisons are also made between two groups of cadets whose individual growth records for four years are at hand. It was found that the groups of men who had had systematic exercise at the Academy were physically superior to those who had not had this exercise. It appears to the reviewer that some of this superiority could be attributed to other causes.

65. BEYER, H. G. Relation Between Physical and Mental Work. *Amer. Phys. Educ. Rev.*, 1900, (5), 149-160.
Confirms the important results of Porter's researches on "Precocity and Dullness," suggests a change in the physical examinations in public schools, and advocates the use of the percentile grade tables in Massachusetts.

66. BÉZY, P. Étude clinique sur la croissance. *Méd. inf.*, 1894, (1), 255-265.

*67. BIEDERT, P. Wagestudien. *Jahrb. f. Kinderheilk.*, 1883, (19), 275-308.
Discussion of the factors that influence the technique of weighing, together with a contribution toward establishing the food requirements of infants.

68. BINET, A. Recherches complémentaires de céphalométrie sur 100 enfants d'intelligence inégale, choisis dans les écoles primaires du départment de Seine et Marne. *Année psychol.*, 1900, (7), 375-428.
It was found that the more intelligent had larger heads.

69. BINET, A. La croissance du crâne et de la face chez les normaux entre 4 ans et 18 ans. *Année psychol.*, 1901, (8), 345-362.
Head measurements (16 items) are reported in tables and compared with the findings of Quetelet, Bowditch, and Vitali.

70. BINET, A. Les frontières anthropométrique des anormaux. *Bull. de la soc. libre pour l'étude psychol. de l'enfant*, 1904.
Deals with the physical development of feebleminded children.

71. BINET, A., Les signes physiques de l'intelligence chez les enfants. *Année psychol.*, 1910, (16), 1-30.
Interesting historically. It contains a few tables of head measurements but deals mostly with stigmata.

72. BINET, A. AND SIMON, T. *Mentally Defective Children.* Transl. New York: Longmans, Green & Co., 1914. Pp. 179.
Norms or so-called "frontiers of abnormality" for boys 6-18 years are given for height and head measures, page 92.

73. BINET, A. AND VASCHIDE, N. Mesures anatomiques chez 40 jeune garcons. *Année psychol.*, 1897, (4) 133-136.
Reports measurements of weight, height and 12 other items for 12-year-old children.

74. BIRD, F. Über die relativen Massverhältnisse des menschlichen Körpers. *Zsch. f. Anthropol.*, 1823, 330-369.
An important early investigation.

*75. BIRK, W. Unterernährung und Längenwachstum beim neugeborenen Kinde. *Berl. klin. Woch.*, 1911, (48), 1227-1231.
This article presents seven curves of individual children measured each week from birth until they left the hospital. Camerer's normal curve of average length is plotted on each graph. The length curves for normal breast fed infants are very similar

to those of Camerer but those of poorly nourished infants show a decided inferiority not only in weight but also in length. This is contrary to the findings of Freund, who found that length is not influenced by poor nutrition. Birk explains this conflict by saying that the children he observed were younger than those of Freund and that the growth was therefore more seriously retarded.

76. Blagovidoff, I. (*Materials for the Investigation of the Health of the Mongolian-Asiatic Races* (*Inorodze*) *in the Province of Simbrisk*). Diss., St. Petersburg: 1886.
Russian, cited by Sack.

*77. Bleyer, A. Periodic Variations in the Rate of Growth of Infants. *Arch. of Pediat.*, 1917, (34), 366-371.
For this investigation 1000 St. Louis babies were measured. Two charts show the average weekly gains during the first and second years. Malling-Hansen's findings are corroborated—minimum growth between mid-April and mid-July, maximum between mid-July and mid-December. These variations are less marked for breast fed infants.

78. Bleyer, A. (Measurements of 2000 School Children) *Arch. de méd. d. enf.*, 1919, (22), 311. Abstr. in *J. Amer. Med. Ass'n.*, 1919, (73), 152.
This research done for the American Red Cross Children's Bureau compares the weight and height of 2000 school children of Vienne, a manufacturing town of France, and of the United States. The Vienne children surpassed the others in height and weight.

79. Boas, F. Anthropological Investigations in Schools. *Ped. Sem.*, 1891, (1), 225-228.
A general discussion, with many historical references as to methods of procedure.

80. Boas, F. Physical Characteristics of the Indians of the North Pacific Coast. *Amer. Anthropol.*, 1891, (4), 25-32.
Studies based on measurements of 263 Indians from Oregon, Washington, and British Columbia, including stature, sitting height, cephalic index, length of arm, etc.

81. Boas, F. Physical Characteristics of the Tribes of the North Pacific Coast. *Brit. Ass'n. for the Adv. of Sci.*, 1891, (61), 424-447.
A detailed study of 26 measurements on a number of individual male and female Indians. No averages are given.

82. Boas, F. Growth of Children. *Science*, 1892, (20), 351-352., n. s. 1897, (5), 570-573.
In this investigation in Worcester the same children were measured twice (May, 1891, and May, 1892). Young children grow more uniformly than older children and growth is more variable with girls than with boys. Short children continue growing for a longer time than do tall children.

83. Boas, F. The Correlation of Anatomical or Physiological Measurements. *Amer. Anthropol.*, 1894, (7), 313-324.
A discussion of the theory of measurements based on measurements of the heads of 377 half-blood Indians, superseded by later work.

84. Boas, F. On the Growth of First-Born Children. *Science*, n. s. 1895, (1), 402-404.
This article contains four very valuable tables on the height and weight and yearly increments of boys and girls between 6½ and 17½ years of age. The study includes the first, second, third,

fourth and later born children The conclusions are that in stature and weight the first-born children exceed the later born children. The study includes Toronto and Oakland children; the latter exceed all others in the United States (at this time) in height and weight.

85. Boas, F. Zur Anthropologie der nordamerikanischen Indianer. *Zsch. f. Ethnol.*, 1895, 366-411.

86. Boas, F. On Dr. Townsend Porter's Investigations of the Growth of the School Children of St. Louis. *Science*, n. s., 1895, (1), 225-230.
A theoretical discussion and some mathematical objections to Porter's work.

87. Boas, F. The Forms of the Head as Influenced by Growth. *Science*, n. s., 1896, (4), 50-51.
This is a discussion of Ripley's article with further data on Europeans.

88. Boas, F. The Growth of Toronto Children. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (6), 443-449.
Standing and sitting height, finger reach and weight are given for Toronto boys and girls, 5½ to 16½ years. Comparisons with Oakland, Calif., children are made. Variability and differences in stature of first-born and later-born children are discussed.

89. Boas, F. The Growth of Toronto Children. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1896-97, (2), 1541-1599. See also *Brit. Ass'n for the Adv. of Sci.*, 1897, (6), 443-449.

90. Boas, F. Summary of the Work of the Committee in British Columbia. *Brit. Ass'n. for the Adv. of Sci.*, 1898, (68). 667-683.
A summary of the measurements on the Indians of the North Pacific Coast, containing 12 extensive tables for 19 measurements on males from 5 to 70 years old.

91. Boas, F. Statistical Study of Anthropometry. *Amer. Phys. Educ. Rev.*, 1902, (6), 174-180.

92. Boas, F. *The Measurement of Variable Quantities.* In Columbia Univ. Contrib. to Philos. and Psychol., New York: Columbia University, 1904, (14), 1-50.
A detailed technical discussion on constants and variables; a comparison between limited series of observations and the unlimited series of variables and the distribution of variables and of chance variations.

93. Boas, F. *Anthropometry of Central California.* Bull. Amer. Mus. Nat. Hist., 1905, (17), 247-380.

94. Boas, F. The Relation between Civilization and Stature. *J. Sociol. Med.*, 1909, (18), 397-401.

95. Boas, F. Changes in Bodily Form of Descendants of Immigrants. *U. S. Senate Documents*, Washington: Gov. Print. Off., 1911, (64). Pp. 573.
This is a painstaking and comprehensive collection of data on physiological development in various nationalities—Bohemian, Hungarian, Polish, Hebrew, Sicilian, Neopolitan and Scotch—revealing a change in type since the time of immigration.

96. Boas, F. Growth. *Monroe's Cyclopedia of Education.* New York: Macmillan, 1912, (3), 187-190.
An excellent summary of the relation of physical growth to the general problem of education, with tables giving stature, sitting height, weight, length of head, width of head, length of forearm, and width of hand for boys and girls.

97. Boas, F. Remarks on the Anthropological Study of Children. *Trans. 15th Intern. Cong. Hyg. & Demogr.*, 1912, (3), Part 1, 413-420.

A good general account of the phenomena of growth. No tables.

98. Boas, F. The Growth of Children. *Science*, 1912, (36), 815-818.

A brief discussion of some of the general laws of growth with special emphasis on pubescent phenomena.

99. Boas, F. Einfluss von Erblichkeit und Umwelt auf das Wachstum. *Zsch. f. Ethnol.*, 1913, (45), 615-627.

100. Boas, F. and Wissler, C. Statistics of Growth. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1904, (1), 25-132.

This is an exceedingly valuable collection of data. In a previous paper (Report of the Commissioner 1896-1897) Boas showed that the assumption of a symmetrical distribution of variations in period—i. e. of accelerations and retardations—following the laws of chance, gives an adequate explanation of the character of the observed curves of growth. If this theory is correct, it follows that the developmental stage of a child at a certain period depends primarily on phenomena of retardation and acceleration which influence the whole body at the same time, so that all measurements of the body would tend to lag behind the normal average or to be in advance of it. The more rapid the rate of growth the greater would be the effect of variations in period upon all the different measurements. Retardation of developmental period, for instance, would considerably depress all the measurements of the individual. Consequently, the correlations between different measurements ought to be closer during periods of rapid growth than at other periods. Statistical analysis of many tables of measurements taken in Worcester, Mass., Toronto, Ontario, and Milwaukee, Wisconsin, show exactly the variations that correspond to this theory.

101. Boas, F. New Evidence in Regard to the Instability of Human Types. *Proc. Nat. Acad. Sci.*, 1916, (2), 713-718.

102. Boas, F. The Anthropometry of Porto Rico. *Amer. J. of Phys. Anthropol.*, 1920, (3), 247-253.

This article reports height and other measurements of 309 children. (See also Spier) Porto Ricans are found to be shorter than Mexican and Italian children, but are not really physiologically retarded as this would seem to indicate.

103. Bobbitt, J. F. The Growth of Philippine Children. *Ped. Sem*, 1909, (16), 137-168. Also 104-112.

A study of the measurements of 1180 native Filipino boys and 438 girls between the ages of six and 20 years, together with a discussion of growth stages and a comparison with the Smedley and Boas norms. A comparison is also made of the growth of the Filipino children with the growth of the Japanese children as given by Misawa.

104. Bolk, L. Over de toeneming in lichaamslengte der mannelijke bevolkung van Nederland. *Nederl. Tijdschr. v. Geneesk.*, 1910, (45), 650-666.

105. Bondyrew,— (Materials for the Study of the Growth of Children.) Diss., 1902.

Russian.

*106. Bouchaud,— *De la mort par inanition.* Thesis, Paris: 1864.

One of the earliest studies giving norms for the growth of infants.

107. Boudin, J. C. M. Études ethnologiques sur la taille et le poids de

l'homme chez divers peuples. *Recueil de mémoires de méd. de chirurg.*, 1863, (9), 169-207; (10), 1-43. Third series.
This is particularly concerned with military requirements. The writer finds fewer exemptions because of shortness of stature have taken place in the last thirty years.

108. Boulton, P. Some Anthropometrical Observations. *Brit. Med. J.*, 1876, Part 1, 280-282.
Contains tables of norms for foetal development and for the growth between 1-12 years, based on the assumption that there is a certain constant relationship between weight and height which holds good during a particular growth period. The writer maintains that weight alone is no criterion of normal development, but that height must also be considered.

109. Bowditch, H. P. The Growth of Children. *8th Ann. Rep., Mass. Board of Health.* Boston: 1875, 273-323.
The data for this investigation were collected from 24,500 children in the public schools of Boston and near-by communities and a few private schools. Comparative study is made of the growth in height and weight and the tables are arranged in such a way that the influence on growth by nationality may be determined.

110. Bowditch, H. P. Growth of Children. *10th Ann. Rep. Mass. Board of Health.* Boston: 1879, (10), 33-62.
This investigation is supplementary to the previous one and contains 11 tables and 11 plates. The tables give the percentage and then the occupations of parents in professional, mercantile, and unskilled labor classes.

111. Bowditch, H. P. The Relation Between Growth and Disease. *Trans. Amer. Med. Ass'n.*, 1881, (32), 370-376.
This is a valuable discussion based on the thesis that "It seems probable that the actual determination of the normal rate of growth will not only throw light upon the nature of the disease to which childhood is subject, but will also guide us in the application of therapeutic measures."
An individual study of the rate of growth of one girl between the ages of 2 and 3 years is included, based on 26 measurements in weight with accompanying health notes from 4 observations.

112. Bowditch, H. P. The Physique of Women in Massachusetts. *Rep. Mass. Board of Health.* Boston: 1890, 287-304.

113. Bowditch, H. P. The Growth of Children Studied by Galton's Percentile Grades. *22nd. Ann. Rep. Mass. Board of Health.* Boston: 1891, (22), 479-525.
Abstract contained in *Amer. Ass'n for the Adv. of Phys. Educ.*, 1891, (6), 36-37.
Applying this method to 24,000 Boston school children, Bowditch concludes: I. The period of accelerated growth in height and weight occurs just before the age of puberty. Large children have their period of accelerated growth at an earlier age than small ones. II. The period when the girls are taller and heavier than the boys occurs earlier in the higher than in the lower percentile grades.

114. Boyd, R. Table of Weights of the Human Body and Internal Organs in the Sane and Insane, etc. *Phil. Trans.*, London, 1861, (151), 241-262.
This table includes ages from before birth to 80 years old and the results show that the body and internal organs arrive at full size in both sexes between 20 and 30 years of age. "The average height of the adult male varied from 67.8 to 65 inches,

and of the female from 63.2 to 61.6 inches, while the mean weight of the former varied from 112.12 to 91.5 pounds, as compared with the sane adults dying at the same period of life." The tables cannot, however, be used as norms, since one determination will be given for ages 7-13, another for 14-19, etc.

*115. BRADY, J. M. Relation of the Weight Curve of the Infant to the Food. *Amer. J. Obstet.*, 1913, (67), 601-609.

Ten charts show the effect of the deprivation of food, excessive diet, etc. on weight. No age growth curves.

116. BRANDT, G. *Die Körpergrösse des Wehrpflichtigen des Reichlandes Elsass-Lothringen.* Strassburg: Trübner, 1898. Pp. 89.

117. BRAUNE, C. W. AND FISCHER, O. Über den Schwerpunkt des menschlichen Körpers. *Abhandl. der math.-physischen Classe d. K. Sächs. Gesellsch. d. Wissensch.*, 1889, (15), 559.

A study of the center of gravity of the human body.

118. BRENT, W. B. On the Stature and Relative Proportions of Man at Different Epochs and in Different Countries. *Brit. Ass'n. for the Adv. of Sci.*, Sept., 1844.

An abstract of a paper giving measurements of 1000 individuals. The average height of the Englishmen is placed at 5 ft. 7½ inches.

119. BRENT, W. B. Tables Illustrative of the Height, Weight and Strength of Man. *Brit. Ass'n for the Adv. of Sci.*, 1845, (15), 80-81.

In these tables men are grouped as tall, middle height and short.

120. BRESCIANI-TURRONI, C. Über die Korrelation zwischen Körpergrösse und Kopfindex. *Arch. f. Rassen u. Gesellsch. Biol.*, 1913, (10), 452-269.

Reports many correlations for different regions of Italy. The correlations were in general small, and some were negative.

*121. BRESLAU,— Über die Veränderung im Gewichte der Neugeborenen. *Denkschr. d. med. chir. Gesellschaft d. Kantons Zürich*, 1860.

*122. BRESLAU,— Neue Ergebnisse aus Schädelmessung an Neugeborenen. *Wien. med. Woch.*, 1862, (50), 785-787.

The author concludes that the head circumference of boys is in all cases greater than that of the girls, i. e., whether the weight of the former be the same or greater or less than the latter and whether the birth be full time or premature.

123. BREZEZÍNSKI, J. AND PELTYN, B. (The Child of the Factory Workman in Zawietle in the Light of Anthropometric Measurements) *Zdowie*, Warszawa, 1914, (30), 572-581.

Russian.

124. BRIGHAM, W. T. Measurements of 300 Chinese. *Proc. Boston Soc. Nat. Hist.*, 1866, (11), 98.

A report on 300 adult Chinese measured on board ship. The mean and extremes for weight, height and chest size are reported. No age tables are given.

125. BRITISH ARMY MEDICAL DEPARTMENT. Ages, Height, Weight, and Chest Measurements of All Recruits Finally Approved for Service During the Year. *Army Med. Dep. Rep.* for 1894, (36), 31-35; for 1895, (37), 30-34; for 1896 (38), 33-37; for 1901, (43), 40-44.

*126. BROUDIC, L. Contribution à l'étude de la progression du poids du nourrisson au cours de la première année. *Nourrisson*, 1919, (7), 15-22. Abstr. in *J. Amer. Med. Ass'n.*, 1919, (72), 1036.

From observations on 2000 infants, the writer took the records

of 300 who had all been weighed at birth and several times thereafter. He gives the weight for 2, 4, 6, 8, 10, 13, 17, 22, 26, 30, 34, 39, 43, 45, 47, 49, 51 and 52 weeks, the averages being based upon 30 to 207 observations for each figure. From these a graph is plotted for increase of weight during the first year. A comparison of his figures for several age points is made with those of Marfan.

127. BROWN, C. R. Anthropometric Notes on the Inhabitants of Clara Island, Ireland. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 510-511.

A study of the average height of 56 adult males giving an average of 66.75 inches.

*128. BRUMMERSTAEDT,— (Birth Measurements of Infants) *Bericht aus der Grossherzogl. Central-Hebammen-Anstalt.* Rostock: 1865, (47).

*129. BRÜNING, H. Zur Frage der Kriegsneugeborenen. *Dtsch. med. Woch.*, 1918, (44), 581.

This is a report and comment on Hoffman's Dissertation.

130. BRUNNICHE, A. Ein Beitrag zur Beurteilung der Körperentwicklung der Kinder. *Jahrb. f. Kinderkrankh.*, 1866, (47), 1-28.

131. BRUNN,— Hygiejniske og anthropometriske Undersögelser i Esbjerg. *Hygiejniske meddelelser*, 1887, 19.

132. BRYAN, E. B. Nascent Stages and Their Pedagogical Significance. *Ped. Sem.*, 1900, (7), 357-396.

This is one of the important articles on physical growth from the standpoint of periods of development. The author bases his conclusions on the work of thirty-seven different writers. After outlining the periods of childhood as differentiated by Hartwell, Lange, Zeising and others, he finds there are three periods: Infancy, childhood and youth. Each of these stages is discussed from the scientific and pedagogical points of view.

*133. BUFFON,— Sur l'accroissement successif des enfants: Guéneau de Montbeillard mesuré de 1759 à 1776. *Oevres complètes.* Paris: Paris: Furne et Cie., 1837, (3), 174-176.

Probably the first instance of successive measurement of a child.

134. BUFFON,— Histoire de l'homme, 11-13. *Oeuvres complètes.* Paris: 1829-1832, 29 vols.

135. BÜRGERSTEIN, L., and others. *Schulhygiene.* Jena: Fisher, 1902, 473-485.

A good summary of anthropometric work with references to American studies, including tables and curves. A short list of references is included.

136. BURK, F. Growth of Children in Height and Weight. *Amer. J. Psychol.*, 1898, (9), 253-326.

This is the most general American contribution to the subject of physical growth up to the year 1898. Most of the significant contributions previous to this are discussed and a number of tables included. Probably the most important single discussion is the series of norms derived from a comparative study of the work of Boas, Bowditch, Porter and others.

137. BURK, F. The Influence of Sex upon Growth. *Amer. Phys. Educ. Rev.*, 1899, (4), 340-349.

The conclusions of this report emphasize the fact that exercise should follow racial habit as far as possible.

138. BURK, F. Influence of Exercise upon Growth. *Rep. of Nat. Educ. Ass'n. of the U. S.*, 1899, 1067-1076.

A general account of the effect of physical exercise on growth.

139. Buschan, G. Das Wachstum und seine Gesetze. *Menschenkunde.* Stuttgart: Strecker und Schroeder, 1909, 68-93.
A general treatise with several tables.

140. Busk, R. W. Vital Index in Development. *Ped. Sem.*, 1917, (24), 1-18.
Historical sketch quoting Porter, Smedley and Baldwin and stating the fact that mental and physical development go hand in hand. Contains comparisons between normal, accelerated, and retarded children in height, weight, and vital capacity from statistics obtained from Colorado school children and those of Smedley from the John Worthy School, Chicago.

*141. Byfield, A. H. and Daniels, A. L. The Antineuritic and Growth Stimulating Properties of Orange Juice. *Amer. J. Dis. Child.*, 1920, (19), 349-358.
Five charts show the favorable effect on the weight of babies and of animals of a diet containing orange juice.

142. Cailli, A. Étude sur les variations de poids observées chez les enfants envoyés à la Montague. *Bull. méd.*, 1903, (17), 849-851.
This contains curves constructed from the weights of 914 children, 3 to 14 years old, who had been sent to the country from city homes. The graphs show the beneficial influence of country living.

143. Camerer, W. Untersuchungen über den Verlauf des Längen- und Gewichtswachstums und deren Beziehungen bei chronischer Unterernährung. *Württemb. ärtzl. Korrespondenzbl.*, (76), 1016.

*144. Camerer, W. Bemerkungen über Wachstum. *Zsch. f. Biolog.*, 1880, 24-28.
A short, detailed study of infant growth which was reprinted in *Jahrb. f. Kinderheilk.*, 1893, (36), 249-293.

*145. Camerer, W. sen. Gewichtzunahme von 21 Kindern im ersten Lebensjahre. *Jahrb. f. Kinderheilk.*, 1882, (18), 254-264.
This contains an extension of the measurements of two of Vierordt's cases with data on 12 new cases. It also gives references for Vierordt's 29 cases collected from the literature and published together with nine of Vierordt's own in his two editions of *Kindsphysiologie.* For Camerer's own cases, data are given in regard to feeding, illness, etc. The article is interesting historically, but the norms could scarcely be used for healthy infants.

146. Camerer, W. sen. *Das Gewichts- und Längenwachstum des Menschen.* Leipzig: 1893.

*147. Camerer, W. Untersuchungen über Massenwachstum und Längenwachstum der Kinder. *Jahrb. d. Kinderheilk.*, 1893, (36), 249-293.
This article begins with a critical discussion of previous work and then presents data included for the most part in the later article (*Jahrb. f. Kinderheilk.*, 1901, (53). 381-446.). For the first year of life Camerer finds the usual phenomena. He believes that the retardation in growth at the end of the third quarter is to be ascribed to dentition. He corroborates Malling-Hansen's work on seasonal variations.

*148. Camerer, W. sen. Das Gewichts- und Längenwachstum des Menschen insbesondere im 1 Lebensjahr. *Jahrb. f. Kinderheilk.*, 1901, (53), 381-446.
This contains (including data previously published) the original tables for 119 breast fed infants and 84 artificially fed infants, each measured weekly to the end of the first year, and

also some data for the second year on 27 children. This material is analyzed in numerous tables and graphs.

149. CAMERER, W. Gewichts und Längenwachstum der Kinder. *Med. Cor. Bl. d. Würtemburg ärztl. Ver.*, 1905, (75), 454-464.

*150. CAMERER, W. jun. *Verhandlungen der Gesellschaft für Kinderheilkunde.* München; 1899, 1.
Contains the average weights for 283 cases.

151. CAMERER, W. Jun. Untersuchungen über das Längen- und Gewichtswachstum bei chronischer Unterernährung. *Verhandl. d. Gesellsch. f. Kinderheilk. in Meran.*, 1905.

*152. CAMERER, W. jun. Children's Growth in Weight and Height. In Pfaundler and Schlossmann's *Diseases of Children.* Philadelphia: Lippincott & Co., 1908, (1), 414-429.
This is a chapter in the English translation of Pfaundler and Schlossmann's *Handbuch der Kinderheilkunde.* It is a good general article with a large number of excellent colored charts.

*153. CAMERER, W. AND HARTMANN, O. Der Stoffwechsel eines Kindes in ersten Lebensjahre. *Zsch. f. Biolog.*, 1878, (14), 383-414.
This contains very exact data on the metabolism and weight of an infant. Determinations were calculated or actually made for every day of the first year.

154. CAMESCASSE, J. E. L. Étude statistique sur l'évolution du pois des enfants de Paris entre quatre ans et quinze ans sur les documents réunis a l'hôpital de Forges-les-Bains (A. P.) de 1904 à 1914. *Archiv. de Méd. d. enf.*, 1918, (21), 113-149. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 1194.
This article analyzes the data of a rural sanitarium and orphan asylum for Paris children. The weight of 2571 boys and 2506 girls was taken at regular monthly intervals. Diagrams are constructed to show normal weight at different ages.

155. CAMESCASSE, J. E. L. Effet de restrictions alimentaires sur l'évolution du poids des enfants à Forges. *Rev. d'hyg.*, 1918, (40), 372-382.
This article deals with an experiment in which, for the sake of economy, bread was replaced by rice and vegetables. The effect upon growth was good, which is not surprising in view of the greater variety in diet.

156. CAMESCASSE, J. E. L. Lois de l'accroissement en pois des enfants; effet des restrictions alimentaires actuelles. *Rev. d'hyg.*, 1918, (40), 337-361.
This article deals with the same experiment as that mentioned in the former reference.

157. CAMPUS, P. *Oeuvres de P. Camper qui ont pour objet l'histoire naturelle, la physiologie et l'anatomie.* Paris: 1803, 3 vols.
Cited for its historical value.

158. CARLIER, G. Des rapports de la taille avec le bienêtre. Recherches anthropologiques sur la croissance. *Mém. Soc. anthropol.*, 1892, (4), 2nd series, 265.

159. CARMON, W. B. Causes of Some Rapid Changes in Body Weight. *J. Amer. Med. Ass'n.*, 1912, (59), 725-771.
A brief discussion of theoretical value.

160. CARSTAEDT, C. Über das Wachstum der Knaben vom 6 bis zum 16 Lebensjahre. *Zsch. f. Schulgesundheitspf.*, 1888, (1), 65-69.
The article contains two valuable tables for comparative purposes. In one, the height of 4274 boys from 6 to 6½ years (in half yearly measurements) is given; in the other, the maxima and minima of height for the same ages are recorded. The measurements were taken in a "Höhere Bürgerschule" in Breslau.

161. Carus, C. G. *Die Proportionslehre der menschlichen Gestalt, zum ersten Male morphologisch und physiologisch begründet.* Leipzig: 1854.

Interesting historically.

162. Cassenilli, L. R. (Development of School Children). *Semana Med.*, 1917, (24), 437. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 579.

Herein are reported the average height, weight, antero-posterior diameter of chest and vital capacity of 1000 Argentine boys and girls, 14 to 16 years.

163. Cattell, J. and Farrand, L. Physical and Mental Measurements of the Students of Columbia University. *Psychol. Rev.*, 1896, (3), 618-648.

A detailed study of mental tests and physical characteristics with some suggestions on anthropometric measurements.

*164. Chaille, S. E. Infants; Their Chronological Progress. *New Orleans Med. & Surg. J.*, 1886-87, (14), 893-912.

This report contains a few measurements and many suggestions for observation.

165. Chamberlain, A. F. *The Child.* New York: Scribner, 1900, 51-106.

A general discussion of the problem of physical growth from the anthropological and educational standpoints.

166. Chaumet, E. *Recherches sur la croissance des enfants des écoles de Paris,* (et des crèches, dispensaires et consultations extérieurs des hôpitaux). Paris: 1906, (60), 80.

167. Chervin, A. Anthropométrie militaire. *J. Soc. de Statist. de Paris,* 1896, (37), 408-428.

168. Children's Bureau. *Table of Heights and Weights.* Washington: U. S. Dep. of Labor, 1918.

This is a convenient table of measurements at three months, six-48 months, and at each year from five to 16, for both boys and girls. The norms are taken from Holt, Crum and Bowditch.

169. Chose,— *Über den Einfluss durchgemachter Rachitis auf die Körpermasse von Schulkindern.* Diss. München: Müller & Steinicke, 1914.

*170. Christoffersen, W. Spaedbarns vaegt og laengde forögelse, (The Weight and Height of New-born Infants). *Tidrskr. for nordisk retsmedicin og psykiatri,* Kristiania: 1905, (4), 15-17.

171. Christopher, W. S. Measurements of Chicago Children. *J. Amer. Med. Ass'n.,* 1900, (35), 618-623; 683-687.

This is a detailed illustrated report of the work done at Chicago by Smedley, Campbell, McMillan, and others in the Chicago public schools. The charts and graphs are included in the report of Smedley, which is noted further along in this bibliography. In the second part of the report, Christopher says: "At the outset of my investigations I determined to reinvestigate Porter's proposition, and have to say that such facts as we have been able to collect go to confirm it."

*172. Clarke, J. Observations on Some Causes of the Excess of the Mortality of Males above That of Females. *Phil. Trans.,* 1786.

Study of 20 males and 20 females, giving weight and a few height measurements.

*173. Cnopf, J. *Protocol der Verhandl. d. Generalversamml. des Ver. mittelfrank. Artzte.* Nürnberg: 1871.

Reports the weight of 13 infants.

Also *Historische Mitteilungen über die Wägungen der Neugeborenen.* Nürnberg: 1875.

174. COHN, M. Die Kenntis der Körperlänge; ein Maszstab für die normale Entwicklung der Schulkinder. *Zsch. f. Schulgesundheitspf.*, 1912, (25), 693-696.

Since year-norms previously established are very confusing because various investigators have used the word "Year" to include different month limits, the writer proposes using norms in the form of tables of measures corresponding to different types. He gives one table of data derived from 90 healthy boys six to 13 years.

175. COMBE, J. Körperlänge und Wachstum der Volksschulkinder in Lausanne. *Zsch. f. Schulgesundheitspf.*, 1896, (9), 569-589.

During the seven years of Combe's investigation 2000 children were measured, giving a sum total of 13,358 measurements. The value of individual measurements is discussed, and also the relation of disease to growth in height at different ages with reference to time of birth in year, and to parentage.

176. CONVY,— Notes anthropométriques sur quelques races du territoire militaire de l'Ichad. *Anthropologie*, 1907, (18), 549-582.

177. CORDEIRO, F. J. B. A Contribution to Anthropometry. *N. Y. Med. J.*, 1887, (45), 484-487.

An illustrated article showing the method of computing height and weight curves, with a number of conclusions and criticisms bearing on the work of other investigators, together with some data on the average maximum and minimum measurements for height, weight, chest, and chest expansion between the ages of 14 and 18 for sailors on the *Minnesota*.

*178. COUDREAU,— *Recherches sur l'alimentation des enfants.* Paris: 1869.

Reports the weight of two infants.

179. COURTIS, S. A. Measurement of the Relation Between Physical and Mental Growth. *Am. Phys. Educ. Rev.*, 1917, (22), 464-481.

An address with 15 graphs, showing the relation between growth in height, weight, lung capacity and grip and mental development, as shown by certain tests. The writer believes that children who are poorly developed physically are also dull mentally, and that physical exercise will accelerate mental development.

180. CRAIG, J. I. Anthropometry of Modern Egyptians. *Biometrika*, 1911-12, (8), 66-78.

Stature, head and other measurements from the same material as that analyzed by Orenstein.

181. CRAMPTON, C. W. Anatomical or Physiological Age versus Chronological Age. *Ped. Sem.*, 1908, (15), 230-237.

A general discussion of the previous work done in this field by the writer and a recommendation that "All observations, records, and investigations of children, whether pedagogical or medical, social or ethical, must regard physiological age as a primary and fundamental basis."

182. CRAMPTON, C. W. Influence of Physical Age on Scholarship. *Psychol. Clinic*, 1908, (1), 115-120.

In this article Crampton discusses the relation of physiological age, as determined by pubescence and height, to "scholarship". The tables are confined to boys (?) between the ages of 12 and 17 years. The conclusion are that "earlier pubescence favors good scholarship; later pubescence poor scholarship."

183. CRAMPTON, C. W. Physiological Age. *Amer. Phys. Educ. Rev.*, 1908, (13), 144-154; 214-227; 268-283; 345-358.

One of the best studies so far made on the age of puberty in boys. The age at which this usually takes place is from 13.5

to 14.5. "Individuals differ from each other in weight (and height) according to their maturity." There is, according to these results, no marked primary relation between scholarship and weight, height, strength, etc.

184. CRAMPTON, C. W. *The Significance of Physiological Age in Education.* Washington: Gov. Print. Off., 1913. Pp. 13. Repr. f. *Trans. of 15th Int. Congr. on Hyg. and Demogr.*

This pamphlet contains some tables for the physical development of pubescent boys with pedagogical and social recommendations.

*185. CRUM, F. S. Anthropometric Table. Chicago: *Amer. Med. Ass'n.* No date; about 1915.

Measurements are given for 10,423 male and female children, six-48 months old, in 31 states. Height, weight, circumference of head, chest and abdomen, diameter of chest, and length of arm and leg are included. These are not original measurements but a compilation from various American sources.

186. CURTISS, F. H. Some Investigations Regarding Loss in Weight and Gain in Height during Sleep. *Am. Phys. Educ. Rev.*, 1898, (3), 270.

187. DAAE, A. AND DAAE, H. Sur la taille, l'envergure, le périmètre thoracique et la hauteur du buste chez les populations de l'intérieur et des côtes de la Norvège. *Bull. et mém. soc. d'anthropol. de Paris*, 1906, 5 S., (7), 158-164.

188. DAAE, H. Die Körpergrösse des norwegischen Volkes. *Norsk. Mag. f. Laegevid.*, No. 7. Cited in *Dtsch. med. Woch.*, 1909, 1281.

189. DAAE, H. Om det Norske Folks Legemshöide. *Norsk. Mag. f. Laegevidensk.*, 1909, 606.

190. DAFFNER, F. Vergleichende Untersuchungen über die Entwicklung der Körpergrösse und Kopfumfanges. *Archiv f. Anthropol.*, 1884, (15), 37-44.

A good discussion of the subject, including many tables.

191. DAFFNER, F. Über Grösse, Gewicht, Kopf und Brustumfang beim männlichen Individuum vom 13 bis 22 Lebensjahre. *Archiv f. Anthropol.*, (Beilage), 1884, (15), 121-126.

Supplementary to the preceding study but confined to males and including chest circumference. A small number of individuals is included; each year from 13 to 22 is taken up separately.

192. DAFFNER, F. Data on Measurements of 6000 California School Children as to Weight and Measurement. *Oakland Sch. Rep.*, 1892-93. See Barnes.

193. DAFFNER, F. *Das Wachstum des Menschen. Anthropologische Studien.* Leipzig: Engelmann, 1902. Pp. 475.

A good study of growth of different parts of the body, starting with the embryo and including puberty.

194. DALLY,— Proportions et croissance relative des membres. *Bull. soc. anthrop.*, 1872. 832.

*195. DANIELS, A. L. AND BYFIELD, A. H. The Role of the Antineuritic Vitamin in the Artificial Feeding of Children. *Amer. J. Dis. Child.*, 1919, (18), 546-554.

This contains seven graphs showing the growth of individual infants. The addition of the antineuritic vitamin to the diet of babies supplied with food containing an adequate number of calories stimulates growth.

196. DANSON, J. T. Statistical Observations Relative to the Growth of the Human Body (Males) in Height and Weight, from 18 to

30 years of Age, as Illustrated by the Records of the Borough Gaol of Liverpool. *Jour. Stat. Soc.*, 1862, (25), 20.

A study of the physical measurements of 4800 prisoners.

197. Davenport, C. B. *Statistical Methods with Special Reference to Biological Variation.* New York: Wiley, 1899. Pp. 148.

A good treatment of methods applicable to the subject.

198. Davenport, C. B. *Heredity in Relation to Eugenics.* N. Y.: Holt & Co., 1911. Pp. 298.

This book contains numerous charts and illustrations of the inheritance of physical as well as other characteristics.

199. Davenport, C. B. Inheritance of Stature. *Genetics*, 1917, (2), 313-389.

This investigation reprinted as Bull. No. 18 of the Eugenics Record Office at Cold Spring Harbor, N. Y. contains an empirical field study and questionary on the inheritance of total stature and segments of stature, with supplementary data on a few special classes including dwarfs and giants. The outstanding conclusions are "that persons of similar stature tend to marry each other. When both parents are tall and of tall stock, practically all of the children are tall or very tall." The opposite of this is also true.

199a Davenport, C. B. The Best Index of Build. *Pub. Amer. Stat. Ass'n.* 1920, (17), 341-344. Also *Amer. J. Phys. Anthrop.*, 1920, (3), No. 4.

Concludes: "The best index of build is the weight divided by the square of the height."

200. Davenport, C. B. and Love, A. G. Defects Found in Drafted Men. *Sci. Mo.*, Jan. 1920, 5-25; Feb. 1920, 125-141.

This is a brief report on defects revealed in the medical examination before local draft boards and in training camps. Numerous graphs show the distribution of physical defects in various parts of the United States. Of special interest is the incidence of deficient measurement, underweight and underheight.

201. David, F. A. *Proportions des plus belles figures de l'antiquité, avec figures accompagnées de leur description par Winckelmann.* Paris: 1798.

Included on account of its historical significance.

202. Davidsohn, H. Die Wirkung der Aushungerung Deutschlands auf die Berliner Kinder. *Zsch. f. Kinderheilk.*, 1920, (21).

Found a considerable decrease in weight and height of Berlin children as a result of war conditions.

203. DeBusk, B. W. Height, Weight, Vital Capacity and Retardation. *Ped. Sem.*, 1913, (20), 89-92.

A brief preliminary study of physical development.

204. Dementiew,— *(The Development of Muscular Force in Man.)* Thesis. Moscow: 1889.

Russian, cited by Wiazemsky. Contains measurements of height.

205. Devraigne, L. L'enfant dans les premières années (observations anatomiques et physiologiques.) *Rev. mens. de gynec., d'obstét. et de pédiat.*, 1914, (9), 166-176.

206. Dick, J. L. *Defective Housing and the Growth of Children.* London: Allen and Unwin, 1919.

This is a study of 2000 Jewish and Christian children from the slums of London. Eighty percent were found to bear the stigmata of rickets due primarily to deprivation of fresh air, sun-

light and exercise, which profoundly alters the metabolism of the child.

207. DICKSON, S. H. Statistics of Height and Weight in the South. *Charleston Med. J. & Rev.*, 1857, (12), 607-613.

Dickson has collected in this report some detailed statistics in regard to the average height and weight of Southern men.

208. DICKSON, S. H. Some Additional Statistics of Height and Weight. *Charleston Med. J. & Rev.*, 1858, (13), 494-506.

In this report a comparison is made between the heights and weight of Americans of different nationalities with the stature and weight of Europeans. Results are based on students of the Medical College of South Carolina, the University of Louisiana, the University of Tennessee, Jefferson College, Virginia Military Institute, the Michigan Academy at West Point, and the University of Michigan. Conclusions show that Europeans increase more in weight than Americans as they grow older. The Americans have on the average greater height.

209. DICKSON, S. H. Statistics of Height and Weight. *Amer. J. of Med. Sci.*, Philadelphia: 1866, (52), 373-380.

This report shows that the new American race, which is growing out of an almost unlimited mixture of other races, exhibits thus far no deterioration, but compares favorably with all the races of the Old World in every point of physical development.

210. DIEK,— Materali k izsledovaniyi roste, viesa, okruzhnosti grundi i zhiznennoo yomkosti lishkickh detskavo i yunoshesk. *Voyenno-med. J.*, 1883, (146), 223-363.

A report of the stature, weight and vital capacity of children in Russia. An inaugural dissertation given in St. Petersburg, cited by Sack.

211. DIKANSKI, M. *Über den Einfluss der sozialen Lage auf die Körpermasse von Schulkindern.* München: Müller & Steinicke, 1914. Pp. 25.

Measurements supplied by Hoesch-Ernst of height and weight of 1843 girls 6-7 years of age are classified according to three social grades. From the averages alone, one would conclude that better social environment is correlated with better physical growth. Since the variations about the mean are greater with rising social class, this conclusion becomes less significant. A comparative table is given for the 10 other investigations.

212. DOLL, E. A. *Anthropometry as an Aid to Mental Diagnosis.* (Public. No. 8 of the Training School). Vineland: 1916. Pp. 99.

This is a study of three physical measurements (height, sitting-height and weight) and three psycho-physical measurements (right and left grip and vital capacity) of 141 girls and 336 boys in an institution for the feebleminded. These measurements are classified according to the mental age of the subjects and compared with the Smedley percentile tables. In all these measurements the feebleminded were found to be below the normal. The writer believes that he has discovered a diagnostic criterion of feeblemindedness in the slope of the line connecting the average of the three physical with the average of the three psycho-physical measurements.

213. DONALDSON, H. H. *Growth of the Brain.* London: 1896. Pp. 369.

Chapters II and III are very good on the general problem of physical growth.

214. DONALDSON, H. H. *A Comparison of the White Rat with Man in Respect to the Growth of the Entire Body.* Lancaster, Pa.: New Era Co., 1906. Pp. 26.

An important comparison between the growth in body weight of the rat for 365 days, and of man from birth to 23 years of age, the latter being based on Robert's tables. The conclusions reached are that "the increase in body-weight of the man and the white rat between conception and maturity exhibit similar phases, five in number."

215. DONALDSON, H. H. Physical Growth and School Progress. *Psychol. Bull.*, 1915, (12), 360-363.
A review and discussion of the contributions to research in physical growth made in B. T. Baldwin's book of the same name.

216. DOTCHEFF, A. *Poids des enfants des écoles primaires de Lausanne.* Lausanne: 1901.

217. DOWNES, R. M. The Interrelationship of some Trunk Measurements and Their Relation to Stature. *J. Anat. and Physiol.*, 1913-14, (48), 299-314.
Measurements of six diameters were made on 201 cases, six months to 90 years of age. Tables of the relationships of indices are calculated from these measures. Females showed a greater range of variation.

218. DRONTSCHILOW, K. Die Körpergrösse der burgärischen Rekruten und ihre Verteilung in den einzelen Distrikten. *Arch. f. Anthropol.*, 1914, n. f. (13), 337-341.
A study of 175,437 subjects, with tables of measurements.

219. DRONTSCHILOW, K. Beiträge zur Anthropologie der Bulgaren. *Arch. f. Anthropol.*, 1915, n. f. (14), 1-76.
A study of 15 measurements of the head on 601 subjects, ages 20 to 52. Many graphs and tables.

220. DU BOIS,— AND DU BOIS,— Measurement of the Surface Area of Man. *Arch. of Intern. Med.*, 1915, (15), 868.
Develops a linear formula for body surface.

221. DU BOIS,— AND DU BOIS,— A Formula to Estimate the Approximate Surface if Height and Weight be Known. *Arch. of Intern. Med.*, 1916, (17), 863.

222. DUBOIS,— Le poids et la taille des enfants 6 à 7 ans à Liége en 1918. *Bull. Acad. roy. de méd. de Belg.*, 1919, 4 s., (29), 1568-1594. 5ch. [Rapp. de Demoor], 1498-1500.

223. DUDREWICZ, L. Pomiary anthropolog. dzieci Warszawskich. *Zboir. wiad. do anthrop.....*Akad. Umiej. w. Krakow, 1882, (6), 3-23.
Anthropological measurements of children in Warsaw.

224. DUFESTEL, L. Des mensurations anthropométriques chez l'enfant. *Pédiatrie prat.*, 1907, (5), 193-198.

225. DUN, W. A. The Police Standard of Cincinnati; with Some Statistics Compiled from the First Thousand Examinations of Applicants. *Lancet-Clinic.*, 1887, (18), 131-135; 767-776.
Contains valuable tables for comparative study on minimum height and weight requirements.

226. DÜRER, A. Folio, Nuremberg: 1528.
Includes 4 books on human proportions.

227. ECKER, A. Zur Statistik der Körpergrösse im Grossherzogtum Baden. *Arch. f. Anthropol.*, 1876, (9).

*228. EDDY, W. H. AND ROPER, C. J. The Use of Pancreatic Vitamin in Cases of Marasmus. *Amer. J. Dis. Child.*, 1917, (14), 189-201.
Shows the effect in stimulating the growth of four infants. One curve extends to the 140th day.

229. ELDERTON, E. M. Height and Weight of School Children in Glasgow. *Biometrika*, 1914, (10), Parts 1 & 2, 288-339.
Measurements of 30,965 girls and 32,811 boys 5½-14½ years

are arranged in four classes from A, the poorest district, to D, a better district. Ages are given to the nearest year, weight to the nearest pound, and height to the nearest quarter inch. Numerous tables are given of the distribution of weight and height and two graphs for comparing the measurements of these children with the standards of the British Association Anthropometric Committee. Various regression coefficients are included.

230. Elliott, E. B. On the Military Statistics of the United States of America. *U. S. Sanitary Commission*, 1863, (4), 44.
A comparatve study of the heights, weights, etc. of soldiers in the Army of the Potomac.

231. Ellis, H. *Man and Woman.* London: 1896, 31-114. Also published by Scribner, New York: 1904, 32-54.
In Cnapter III of this book there is a good discussion of the growth and proportions of the body. A number of references are given and four charts from Key showing the relative increments of growth in height and weight from seven to 20 years of age. The relative proportions of different parts of the body of man and woman are compared.

232. Elsholt, J. S. *Anthropometria*, sive De mutua membrorum corporis humani proportione. Padua: 1654.
This is one of the first works on anthropometry and as such is chiefly concerned with symmetry and aesthetic values. It contains pictures of the perfect body and of old anthropometric instruments. No tables.

233. Elson, J. C. Statistics Regarding Short Course Students. *Amer. Phys. Educ. Rev.*, 1910, (15), 348-349.
A brief article which shows that in a study of 8000 college students the short course men (men who are taking special courses in agriculture) surpass in all measurements, except height, the men of the present freshman class.

234. Emerson, W. R. P. and Manny, F. A. Weight and Height in Relation to Malnutrition. *Arch. of Pediat.*, 1920, (37), August.
The figures of Holt, Boas, Burk and other investigators were assembled into tables showing the weight for each inch of height from 21-68 inches for children of average weight and those underweight, and tables showing the increases in weight at various years. The article is principally interested in establishing "zones" of measurements for diagnosing nutritional condition.

235. Enebuske, C. J. An Anthropometrical Study of the Effects of Gymnastic Training on American Women. *Amer. Stat. Ass'n. Papers on Anthropometry*, 1894, 47-57.
One hundred students (19-42 years of age) of the Boston Normal School of Gymnastics were measured before and after 7 months' training. The effect on height, weight, and lung capacity is shown by tables. See also Some Measurable Results of Swedish Pedagogical Gymnastics, *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1892, (7), 207-255, which contains a report of observations made by M. Aura Wood on 26 students of the Boston Normal School of Gymnastics. Eight tables are included and a plea is made for casuistic study in place of isolated statistical measurements.

236. Engelhorn,— Über den Ernährungszustand der Schulkinder im 2. Kriegsjahr. *Zsch. f. Kinderforsch.*, 1915-16, (21), 248-250.
On the basis of 4000 examinations of school children (by the method of inspection) it was found that the children were in better condition than in peace times. This result is attributed to a more sensible diet, withdrawal of sweets, etc.

237. ENGELHORN,— Über den Ernährungszustand der Schulkinder im Kriegsjahr. *Zsch. f. Kinderforsch.*, 1916-17, (22), 64-65.

During this year 1371 children were examined. Somewhat fewer were found to be in "good" condition, more in "medium" and more in "poor" nutritional condition, among the city children. The country children were found to be in good condition.

238. ERISMANN, F. Schulhygiene auf der Jubileumsausstellung der Gesellschaft für Beförderung der Arbeitsamkeit in Moskau. *Zsch. f. Schulgesundheitpf.*, 1888, (1), 367-373; 393-419.

The latter part of this report gives comparative tables with discussions on the height and weight of about 3000 boys and 1500 girls in the schools of the city of Moscow, and 4300 boys and 700 girls in the nearby village schools.

239. ERISMANN, F. Untersuchungen über die körperliche Entwicklung der Fabrikarbeiter in Zentralrussland. *Arch. f. soz. Gesetzgeb. u. Statis.*, 1888, (1), 98. Also printed separately, Tübingen: Laupp, 1889. Pp. 96.

A detailed study of height, chest circumference, weight and muscular strength, and of the factors that influence them. The data are analyzed by occupations and races. Tables and graphs.

240. ERISMANN, F. *Untersuchungen über die körperliche Entwicklung der Arbeiterbevölkerung.* Tübingen: 1889. Reprinted from *Arch. f. soz. Gesetzgeb. u. Statis.*

The latter part of this report deals primarily with hygiene and gives the results of the measurements of 24,288 boys and 16,032 girls ranging from seven to 18 years, taken from city schools, village schools, and factories.

241. ERNST, L. H. AND MEUMANN, E. *Des Schulkind in seiner körperlichen und geistigen Entwicklung.* Leipzig: Nemnich, 1906. Pp. 143.

This book contains a fairly complete summary of the previous investigations upon physical growth and development, and a series of charts which give the growth curves as found by the different investigators. The authors' own work consists in a study of 300 Zürich children, with regard not only to height and weight but also lung capacity, span of arms and various girths. These figures are presented in detailed tables and the authors' conclusions are compared with those of previous investigators.

242. EULENBURG,— Militärsanitätswesen. *Realencyclopädie*, 1910, (12), 485.

Eulenburg tried Pignet's formula on 10,000 recruits, but found it unsuitable for individual cases.

243. EYERBISH,— AND LÖWENFELD,— *Über die Beziehung des Kopfumfanges zur Körperlänge und zur geistigen Entwicklung*, Wiesbaden: Bergmann, 1905.

*244. FABER, H. K. A Study of the Growth of Infants in San Francisco with a New Form of Weight Chart. *Arch. of Pediat.*, 1920, (37), 244.

Presents a new chart plotted from the average weights of babies in maternity hospitals and clinics. This curve is higher than the curve of Griffith.

245. FARR, W. Table Showing the Relative Stature of Boys at the Age 11 to 12, Under Different Conditions of Life. *Brit. Ass'n for the Adv. of Sci.*, 1880, (1), 128-159.

A report of the committee of the Association, appointed originally in 1875, for the purpose of continuing the collection of observations on the systematic examination of heights, weights,

etc., of the human frame in the British Empire, and the publication of photographs of the typical races of the Empire. In 1879, 46 different classes of subjects were included, giving a sum total of 11,745 individuals, while in the 1880 study one class of subjects was included, or 11,956 individuals. There are several excellent distribution tables giving the mean measurements for boys and men between 10 and 50 years, there being in all three charts (plates) and 27 tables. This is a valuable and suggestive report.

*246. FASBENDER,— (Birth Measurements of Infants). *Zsch. f. Geburtsh. u. Gynäk.*, 1878, (3), 278.
Reports the fact that first-born children are shorter than later born children.

*247. FAYE, L. *Nogle undersögelser angaaende nyfödte börns ernaeringsforhold.* Diss. Kristiania: 1874.

248. FAYE, L. Om Legemsveksten, Saerlig hos Nordboerne. *Kristiania Videnskapsselskaps forhandl.*, 1914, 6.

*249. FAYE, L. AND VOGT,— (Birth measurements of 2,677 cases) *Norsk. Mag. f. Lägev.*, 1866.

250. FEER, E. *Lehrbuch der Kinderheilkunde.* Jena: Fischer, 1911, Pp. 741.
This book is largely a text on children's diseases, but contains some general considerations on the subject of growth.

251. FERGUS, W. AND RODWELL, G. F. On a Series of Measurements for Statistical Purposes, Recently Made at Marlborough College. *J. Anthropol. Inst. of G. Brit. and Ire.*, 1874, (5), 126-130.
A short study of the college student.

252. FERI, C. Note sur le rapport de la longueur du tronc à la taille. *Anthropologie*, 1893, (4), 697.

*253. FESSER,— *Gewichts-und Längenverhältnisse der menschlichen Früchte.* Diss. Breslau: 1873, 10-15.

*254. FLEISCHMANN, L. Über Ernährung und Körperwägungen der Neugeborenen und Säuglinge. *Wien. Klinik*, 1877, (3). 145-194.
An interesting article historically. It emphasizes the importance of weight as an index of growth and insists upon following individuals throughout the period observed, instead of making a few determinations and interpolating values according to some formula. An account of the early work is included but without references. A number of individual curves are appended and one table is given of average weights from one to twelve months.

*255. FLEISCHNER, E. C. The Relation of Weight to the Measurements of Children During the First Year. *Arch. of Pediat.*, 1906, (23), 739-760.
Five hundred children are divided rather arbitrarily into three classes: the well nourished, the fairly well nourished, and the poorly nourished. Nine tables and 12 charts are given, comparing the height, weight, circumference of head, chest and abdomen, in these three classes of infants. The conclusion is drawn that during the first year of life the primary factor in the increase of the measurements is the increase in weight, the influence of age being secondary. The curves for the three classes run almost parallel but at different levels, which appears to be too schematic for probability. No tables of actual measurements; but increments are given.

256. FOCK, H. C. A. L. Mémoire sur les proportions du corps de l'homme. *Compt. rend. acad. d. sci. de Paris*, 1850, (30), 661.

In this paragraph without tables, the Appollo Belvedere was taken as the model for human proportions.

257. Forbes, H. O. On the Kubers of Sumatra. *J. Anthropol. Inst.*, 1884-85, (14), 121-128.
A careful study of 12 Kubers from the central part of Sumatra, including detailed measurements.

258. Forbes, J. D. On the Results of Experiments Made on the Weight, Height, and Strength of About 800 Individuals. *Brit Ass'n. for the Adv. of Sci.*, (Transactions of the section on mathematics and physics), 1836, Part 2, 38.
This is a brief report showing that these curves coincide with those of Quetelet, full growth being scarcely completed by 25 years.

259. Forssberg, E. (Anthropometrical Researches on a Cavalry Regiment.) *Tidskr. i. mil. Helsov.*, 1897, (22), 139-178.
Russian.

260. Foster, A. B. Report of Director of Physical Training. *Amer. Phys. Educ. Rev.*, 1898, (3), 44-53.
Reprinted from the annual report of the president of Bryn Mawr College, containing measurements on freshmen, sophomores, juniors and seniors, and discussing various kinds of physical exercise.

261. Foster, W. L. Physiological Age as a Basis for Classification of Pupils Entering High Schools, and Relation of Pubescence to Height. *Psychol. Clinic*, 1910-11, (4), 83-88.
A study of the physiological age of 459 boys with the conclusions that there is a close relationship between height and pubescence, and that a classification of high-school students according to physiological age, based upon pubescence, is easy and practical.

262. Fourmann, F. *Woven is das Gewicht der Neurgeborenen abhängig?* Diss. Bonn: 1901.

263. Frankel, L. K. and Dublin, L. I. *Heights and Weights of N. Y. City Children 14-16 Years of Age.* N. Y.: Metropolitan Life Ins. Co., 1916. Pp. 53.
This is a thorough analysis with 20 tables, and 11 graphs of the data obtained by measuring the height and weight of 10,043 children who received employment certificates in New York City in 1915.

*264. Freeman, R. G. Weights and Measurements of Infant Children in Private Practice Compared with Institution Children and School Children. *Trans. Amer. Pediat. Soc.*, 1914, (26), 203-210.
The weight and height of 120 especially well-cared for infants, 1-12 months, are compared in graphs with the measurements of 1000 orphan asylum infants and with the norms of Holt and Camerer. Comparative graphs are also given for 278 well cared for children, 1-13 years, 1000 orphan asylum children and 98,000 school children. Children under good medical control were found to be superior in physical development.

265. French, M. S. *Report of the Physical Examination of Men upon the Police Force of Philadelphia, and Those who were Applicants for Appointment.* Philadelphia: 1885.

*266. Freund, W. Zur Pathologie des Längenwachstums bei Säuglingen und über das Wachstum debiler Kinder. *Jahrb. f. Kinderheilk.*, 1909, (70), 752-773.
Herein are presented the growth curves of 36 infants for the greater part of a year. Fourteen graphs are given comparing pathological growth processes with the norms of Schmid-Mon-

nard. In some diseased conditions (especially short, acute infections) there was little distortion of the growth curve of height, although weight was much affected. Under other conditions the height curve failed to rise for a considerable period.

267. FRIEDENTHAL, H. Über das Wachstum des menschlichen Körpergewichtes in den verschiedenen Lebensaltern und über die Volumenmessung von Lebewesen. *Mediz. Klinik*, 1909, (5), No. 19, 700-703.

Comparative curves are given for growth in weight of man and the other mammals, showing a great similarity, especially between man and the anthropoid ape.

268. FRIEDENTHAL, H. Daten und Tabellen betreffend die Gewichtszunahme des Menschen und anderer Tierarten. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 221-274.

Consists largely of tables and graphs comparing man and animals.

269. FRIEDENTHAL, H. Das Wachstum des Körpergewichts der Menschen und anderer Saugetiere in verschiedenen Lebensaltern. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 49-73.

Further data on the growth curves of man and animals, with numerous tables.

*270. FRIEDENTHAL, H. Das Wachstum menschlichen Säuglinge in den ersten Monaten nach der Geburt. *Verhandl. d. physiol. Gesellsch. zu Berl.*, 1911, (35), 75-78.

271. FRIEDENTHAL, H. Über das Wachstum des menschlichen Körpergewichts in den verschiedenen Lebensaltern und über die Volumenmessung von Lebenwesen. In *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 40-48.

Further comparisons of growth in man and animals, with two charts.

272. FRIEDENTHAL, H. Experimentelle Prüfung der bisher aufgestellen Wachstumsgesetze. In *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, Part 2, 76-82.

Discussion of the curve of growth in man and animals. The writer finds it impossible to formulate a general law of growth at this time.

273. FRIEDENTHAL, H. Über Wachstum. *Ergebn. d. inn. Med. u. Kinderheilk.*, 1912, (8), 254-299; (9) 505-530; 1913, (11), 685-753.

Part I is a physiological introduction.

Part II gives comparative tables of weight from Camerer, Quetelet, Landois, Beneke, Roberts, with much original material.

Part III gives similar tables for height and other physical measurements with drawings of the human body to show where the measurements are taken.

274. FRIEDENTHAL, H. *Allgemeine und spezielle Physiologie des Menschenwachstums.* Berlin: Springer, 1914. Pp. 161.

A scientific presentation of the physiological and anthropometric work on growth. It includes sections on the chemistry and physics of organic growth, comparison of growth in man and other higher organisms, tables of measurements of height and weight increase in fetal and post-natal life, and of the proportions of the human body. Some of the material in this book has been included in previous articles. The writer mentions as his chief theses: 1st, no "growth energy" can be calculated from

the caloric value of the nourishment taken in by the individual; 2nd, the physiological comparison of new-born individuals from the different zoological, mammalian orders is unreliable; 3rd, conclusions as to the speed of growth should be derived not from the weight curves but from the increment curve; 4th, age is to be calculated from conception rather than from birth.

275. Fröhlich, H. Die menschliche Körperlänge. *Allgemein. med. Centralzeit.*, 1896, (65), 69-70; 82-83; 94-95; 107; 119-120; 132-133; 144-145; 156-157.

This is a survey of previous work on physical growth, the effect of climate, racial differences in development, military anthropometry, and the effect of social status and occupation. No tables.

*276. Fuchs, K. *Die Abhängigkeit des Geburtsgewichts der Neugeborenen vom Stand und der Beschäftigung der Mutter.* Diss., Halle; 1899.

*277. Fuhrmann, F. Einiges über die Gewichtkurven der Neugeborenen. *Med. Klinik,* 1907, 510.

278. Gaertner, G. Körpergewicht und Körperlänge des Menschen. *Wien. med. Woch.*, 1912, (62), 317-322.

A general discussion of the formulae used to express the relation of height and weight. A table is given for the normal weight of men and women for each centimeter increase of height. This table, worked out by the writer's formula, is based on the assumption that the 25 year old man of 170 cm. should weigh 70 kgm. and that the 25 year old woman of 165 cm. should weigh 60 kgm.

279. Galton, F. On the Height and Weight of Boys, Aged 14 Years, in Town and County Public Schools. *J. Anthropol. Inst.*, 1873-74, (3), 308-311.

Comparisons are made between 509 city boys, 296 country boys and others ranging from 10 to 17 years of age: it is found that the country boys are about 1¼ inches taller and 7 pounds heavier than the city boys.

280. Galton, F. Report of the Anthropometric Committee. *Brit. Ass'n. for the Adv. of Sci.*, 1881, (51), 225-272.

This is an early report of the committee appointed in 1875. It contains numerous tables with especially valuable statistics of height and weight.

281. Galton, F. Report of the Anthropometric Committee. *Brit. Ass'n. for the Adv. of Sci.*, 1883.

This is the final report of the committee appointed in 1875 and includes valuable data on the growth of boys and girls at birth and during subsequent ages, including adult life. While this report deals with adults primarily, the height and weight at birth of 451 boys and 466 girls are included.

282. Galton, F. An Anthropometrical Laboratory. *J. Anthropol. Instit.*, 1884-85, (14), 205-221.

A description of the anthropometrical laboratory, which aimed to show to the public the simplicity of the instruments and methods by which the chief physical characteristics may be measured and recorded.

283. Galton, F. Anthropometric Percentiles. *Nature*, 1884-85, (31), 223.

In this article Galton gives a percentile table of the persons measured in the anthropometric laboratory at the late international health exhibit. The table is given primarily as a sample of the statistical method, and secondarily for its intrinsic value.

There were in all 9337 persons measured between the ages of 23 and 50.

284. GALTON, F. Some Results of the Anthropometrical Laboratory. *J. Anthropol. Inst.*, 1884-85, (14), 275-288.
The results of measurements on 9337 persons, 4726 adult males and 1657 adult females. Percentile tables are given.

285. GALTON, F. Hereditary Stature. *J. Anthropol. Inst. of Gr. Brit. and Ire.*, 1885-86, (14), 488-499.
A short report of Galton's findings in regard to the inheritance of stature.

286. GALTON, F. Family Likeness in Stature. *Proc. Roy. Soc.*, 1886, (40), 42-73.
A detailed statistical study showing the correlation between the probable stature of a child when the statures of several of his kinsmen are known. The Appendix by Dixon gives eight tables showing the relation of the adult children of the mid-parents.

287. GALTON, F. Useful Anthropometry. *Amer. Ass'n for the Adv. of Phys. Educ.*, 1891, (6), 51-57.
A discussion of the means of investigating the best method of assigning marks for physical efficiency based on anthropometric tests. A study of 2000 students at Cambridge revealed conclusively, according to Galton's observations, that success in the literary examinations is in no manner connected with stature, weight, strength, or breathing capacity, and but slightly with keenness of eyesight.

*288. GANJOUX, E. Essai sur l'évolution du poids et de la taille chez l'enfant. *Annal. de méd. et chir. inf.*, 1909, (13), 37-43.
Gives the general laws of growth and the times at which a child's birth weight is doubled, tripled, etc.

289. GARDINER, C. F. AND HOAGLAND, H. W. Growth and Development of Children in Colorado. *Trans. Amer. Climat. Ass'n.*, 1903, (19), 258-264.

290. GARSON,— Report of the Committee Appointed for the Purpose of Calculating the Anthropological Measurements Taken at the Newcastle Meeting of the Association in 1889. *Brit. Ass'n. for the Adv. of Sci.*, 1890, (60), 549-552.
Measurements of standing, kneeling and sitting heights, and of length and breadth of the head are given for 81 males and 44 females.

291. GEISSLER, A. AND UHLITZSCH, R. Die Grössenverhältnisse der Schulkinder im Schulinspektionsbezirk Freiburg. *Zsch. des könig,. Sächs. statis. Bur.*, 1888, (34), 28-40.
This investigation was begun in 1866 for the purpose of fitting school desks, and is a comparative study of the boys and girls of the Freiburg Bürger Schulen and of those of the peasant classes in nearby communities. 21,173 children were in the schools, ranging from 6½ to 14½ years of age. A critical study of the arithmetical average is included.

292. GEISSLER, A. Messungen von Schulkindern in Gohlis-Leipzig. *Zsch. f. Schulgesundheitspf.*, 1892, (5), 249-253.
A supplementary consideration of the greater height of the favored classes, based on new data which consists of the measurements of 2806 children at the end of the summer vacation in 1889.

293. GIHON, A. L. A Study of Adolescent Growth Based on the Physical Examination of 6129 Naval Cadets and Candidates for

Appointments as Cadets and 2058 Naval Apprentices. *Rep. of the Surg. Gen. U. S. Navy.* Washington: 1880, 15-44.

294. GILBERT, J. A. Researches on the Mental and Physical Development of School Children. *Stud. f. Yale Psychol. Lab.*, 1895, (2), 40-100.

The curves charted consist of those of the growth of boys and girls for each sex separately; the mean variation for both sexes, then each sex separately.

295. GILBERT, J. A. Researches on School Children and College Students. *Univ. of Iowa Stud. in Psychol.*, 1897, (1), 1-39.

Supplementary to the previous investigation with extra data, especially on dullness and precocity. The curves for height, weight and lung capacity and for dullness and precocity are included. Tests on various mental traits are included.

296. GIUFFRIDA-RUGGERI, V. Nuovi studi sull' anthropologia dell' Africa orientale. *Arch. per l'anthropol.*, 1915, (45), 133-179.

This is a study of height, cephalic index and nasal index with one table compiled from the measurements by several authors and much bibliographical material in footnotes.

297. GODDARD, H. H. The Height and Weight of Feebleminded Children in American Institutions. *J. of Ment. & Nerv. Dis.*, 1912, (39), 217-235.

The most comprehensive study, so far published, on the growth, height and weight of feebleminded children. Four tables and seven charts are included and the data are derived from 20 institutions. Some of the conclusions are that all defectives are heavier at birth than normals; sex differences are less marked as we go down the grades; with the morons there is an arrest of growth earlier than with the normals; there is close correlation between physical growth and mental activity.

298. GODIN, P. Determination de "l'adolescent type" aux différents âges pubertaires d'apres 36,000 mensurations sur 100 sujects suivis individuellement de 13 à 18 ans. *Bull. et Mém. Soc. d. Anthropol. de Paris*, 1902, S. 5, (3), 717-718.

A résumé without tables.

299. GODIN, P. *Recherches anthropométriques sur la croissance des diverses parties du corps.* Paris: 1903. Prix Broc. Pp. 212.

Reports continuous measurements (175 items) on the same 100 pupils of a military school from the years 13½-17½. Also contains a chapter on the determination of puberty by the anthropometric method.

300. GODIN, P. Alternances des accroissements (semestriels) au cours du developpement du corps humain (dans le sexe masculin). *Soc. de biol.*, 1910, (68), 1119-1121.

A note with four graphs showing that growth from 13 to 18 years is irregular.

301. GODIN, P. Quelques conclusions de mes recherches sur la croissance chez l'homme relatives à la puberté. *Compt. rend. d. acad. d. sci. de Paris*, 1911, (153), 967-969.

General conclusions only; no tables.

302. GODIN, P. L'accroissement inégal à l'époque de la puberté et les états pathologiques qu' il peut déterminer. *Compt. rend. d. acad. d. sci. de Paris*, 1912, (155), 66-68.

Remarks about the physiological resemblance between embryonic and pubertal growth. No tables.

303. GODIN, P. *La croissance pendant l'âge scolaire.* Neuchâtel: Delachaux et Niestle, 1913. Pp. 286.

These are lectures with educational applications, on the general

facts of growth. A number of curves are appended showing the growth of parts of the body in various ages.

304. GODIN, P. Lois de croissance. *Compt. rend. d'Inst. franc. d'anthropol.*, 1913, 191-194.
This is a very brief statement of the writer's 28 laws of growth which he has mentioned in almost the same form in other places.

305. GODIN, P. Une série de lois de croissance basées sur 2,000 observations d'enfants, 300,000 mesures et 100,000 notations: 1891-1893-1914. *Compt. rend. d. acad. d. sci. de Paris*, 1914, (159), 99-102.
In this article 28 conclusions are drawn from the writer's previous work, to which he gives references.

306. GOHDE, G. Die Ernährung der Jugend während des Krieges. *Zsch. f. Schulgesundheitspf.*, 1916, (29), 338-339.
A note of the results of the examination of 913 children of Bochum, weighed every two weeks from November, 1915, to February, 1916. The children showed normal increase in weight, as did also 215 children from less well-to-do families.

*307. GOLDFELD, Z. Die Abhängigkeit der körperlichen Entwicklung Neugeborener vom Berufe der Eltern. *Zsch. f. Geburtsh. u. Gynäk.*, 1912, (72), 407-437.
This contains a good account of the literature of this phase of the subject and gives data for the weight and length of infants at birth classified according to the occupation of the father (17 headings). The children of teachers were found to be the best developed, those of day laborers least developed.

308. GOODALL, E. The Systematic Collection of Anthropological Data in Asylums. *J. of Mental Sci.*, 1898, (44), 235-240.

309. GOODALL, E. Remarks on the Anthropological Examination of Asylum Patients, with a Scheme for the Same. *Brit. Med. J.*, 1901, (2), 1240-1242.
A plan for examination to determine whether stigmata occur more frequently in the insane than in the normal.

310. GOROKHOFF, D. Y. (On the Physical Development of Children). *Vestnik. obshtsh. hig. sudeb. i. prakt. med.*, 1916, (3), 1051-1058.
Russian.

311. GOULD, B. A. Investigations in the Military and Anthropological Statistics of American Soldiers. *U. S. Sanitary Commission*, N. Y.: 1869, (2). Pp. 655.
A comprehensive study of military statistics with numerous tables.

*312. GRAANBOOM, J. *De voeding van den Ziugeling.* Amsterdam: van Rossen, 1899. Pp. 98.

313. GRATSIANOFF,— *(Materials for the Investigation of Physical Development in Childhood and Youth in Relation to Heredity and to Progress in School Work.* From observations made in Arzamas, Province of Novgorod.) Diss. St. Petersburg: 1889.

314. GRAUPNER, H. Wachstumgesetze der Körperlänge nach Untersuchung von 57,000 Dresdener Schulkinder. *Ber. d. erst. Internat. Kongr. f. Schulhyg.*, 1904, (1), 421-425.
This investigation corroborates the crossing of the growth curves of boys and girls at about 10 years of age. It shows that physical development is parallel to mental development. No growth curves are given, but the data are expressed to show the percent of children of different heights who are in each school grade.

315. GRAY, F. J. Diurnal Variations in Weight. *Amer. Phys. Educ. Rev.*, 1910, (15), 6-14.

A thesis presented for bachelor's degree in physical education at the International Y. M. C. A. training school, in June, 1908. After making comparisons with the work of M. A. Burke, H. Carrell, H. Cook, B. B. Forte, C. H. Goodwin, A. Gould, and others, the writer finds that all men gain "during the season." Seasoned athletes gained less during a season of training than green athletes.

316. GREENWOOD, A. Health and Physique of School Children. *Ratan Tata Foundation*, Univ. of London, 1915.

Includes 350,000 measurements of English school children.

317. GREENWOOD, J. M. Heights and Weights of Children. *Rep. Board of Educ., Kansas City*, 1890-91. See also *Rep. Amer. Pub. Health Ass'n.*, 1892, (17), 199-204.

The chief value of this study consists in the number of measurements included.

318. GREGOR, W. Galloway Folk in Wightshire and Kirkendbrightshire. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 500-503.

A comparative study of the heights of 82 men and 34 women, the height for the men averaging 68.25 inches, for the women 63 inches.

*319. GREGORY, J. Über die Gewichtsverhältnisse der Neugeborenen. *Arch. f. Gynäk.*, 1871, (2), 48-65.

The usual physiological loss is found in the case of 60 infants. No special contribution to theory is made.

*320. GRIFFITH, J. P. C. Weight in the First Two Years of Life. *N. Y. Med. J.*, 1899, (69), 292-297.

This article presents and criticizes briefly the results of previous investigations. Comparative graphs are given and also a weight chart, with a curve to represent the average growth of healthy normal infants (based principally on the data of Camerer).

*321. GRIFFITH, J. P. C. *The Care of the Baby.* Philadelphia: Saunders, 1909. Pp. 455.

A manual for mothers and nurses containing some material on physical development and a weight chart.

322. GRIFFITH, J. P. C. The Weight of Clothing and Its Relation to the Weight of the Child in First Five Years of Life. *N. Y. Med. J.*, 1917, (106), 823.

This gives tables for 104 children showing the average weight of clothing for use when children must be weighed with clothing.

*323. GRIFFITH, J. P. C. *The Diseases of Infants and Children.* Philadelphia: Saunders, 1919, (1), 19-37.

A general treatise on childrens' diseases with a section on physical development. A growth chart for children up to 2 years is given, but not the data upon which the chart has been plotted.

324. GRINEVSKI, A. (On the Physical Development of Children) Odessa: 1892. Pp. 36.

Russian.

325. GROVER, J. I. Some Measurements of Normal Children, Especially of the Leg and Arm. Some Interesting Deductions and Practicable Possibilities. *Arch. of Pediat.*, 1915, (32), 473-486.

Measurements were made (on 500 normal-appearing children) of height, weight, length of leg and arm, circumference of head and chest, and antero-postero dimension of the head. (Ages one mo. to 12¾ years). One table and 10 graphs are given and com-

parisons are made with the measurements of a Mongolian and a Cretin.

326. GRÜNBAUM, O. F. F. On the Physical Characteristics of the Inhabitants of Barrington and Foxton in Cambridgeshire. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 505.
A comparative table showing the height of 23 males varying from 153.3 cm. to 174.4 cm.

327. GRUZDEFF, M. Y. (Natural Division of the Child's Growth According to the Four Weight Coefficients). *Russk. Vrach.*, 1912, (11), 2112-2116.
Russian.

328. GULICK, L. *Manual for Physical Measurements.* New York: International Committee of Y. M. C. A., 1892.
One of. the early handbooks with pictures to illustrate the methods of taking measurements. No norms.

329. GULICK, L. The Value of Percentile Grades. *Amer. Statis. Ass'n.* (quarterly), 1893, (21), 321-331.
A detailed discussion of the theoretical significance of the percentile method of using data.

330. GULICK, L. Physical Measurements and How They are Studied. *Phys. Educ.*, 1893, (2), 140-141; 152-153; 186-191.
A series of practical suggestions on how to make, record, and study physical measurements.

331. GUNDOBIN, N. *(Die Besonderheiten des Kindesalters)* Petersburg: 1905. Pp. 450.
Russian.

332. GUNDOBIN, N. Die Besonderheiten des Kindesalteres. *Jahrb. f. Kinderheilk.*, 1907, (65), 720-732.
This article is a German translation of the first chapter of the author's book of the same title, published in Russian in 1905. The article consists of a theoretical discussion of the pathological factors influencing physical growth.

333. GUTTMANN, M. Messungen an normalen und abnormalen Kindern. *Med. f. Alle.*, 1906, (1), 266-280.

334. GUTTMANN, M. Einige Beispiele individueller körperlicher Entwicklung. *Zsch. f. Kinderheilk.*, 1915, (13), 248.

*335. HAAKE, H. Über die Gewichtsveränderung der Neugeborenen. *Monatsch. f. Geburtsk.*, 1862, (19), 339-354.
A review of the early literature, together with the result of weighing 100 infants daily for 9 days. No theory of the cause of the physiological loss.

336. HAEBERLIN, C. Über die körperliche Entwicklung von Kindern im Frieden und Krieg. *Arch. f. Kinderheilk.*, 1916, (66), 370-384.
The author has taken records for 10 years of the growth of children in Wyk (probably not the same individuals). Height, weight, chest circumference, muscular strength, haemoglobin, etc. were determined for several thousand children. Comparison of the measurements taken before and during the war show no bad influence of war conditions. The writer gives valuable comparisons on various other factors influencing physical growth. An annotated reference table of 19 titles serves as a guide for important studies of measurements during peace and war-time made previous to this investigation.

337. HADDON, A. C. On the Physical Characteristics of the Inhabitants of Barley, Herts. *Brit. Ass'n for the Adv. of Sci.*, 1897, (67), 504-505.
A number of measurements are included in this report on the observations of 15 males from Barley.

338. HAGEN, B. Die Körpergrösse chinösishcer Frauen. *Arch. f. Anthropol.* 1901, (27), 265-266.

*339. HAEHNER, H. Über die Nahrungsaufnahme des Kindes an der Mutterbrust und das Wachstum im ersten Lebensjahre. *Jahrb. f. Kinderheilk.*, 1880-1881, (15), 23-79.

Tables are given for the increase in weight of a female infant after each feeding (mother's milk exclusively up to the 23rd week) from the first to the 26th week. From these are calculated the exact amount of food taken with the resultant effect upon the growth.

340. HALL, G. S. *Adolescence.* New York: D. Appleton, 1904. Pp. 589 (Vol. 1) and 784 (Vol. 2)

A comprehensive treatise on adolescence, its psychology and its relation to physiology, anthropology, sociology, sex, crime, religion and education. Vol. 1, pp. 1-50 contains a good summary, without direct experimental data, of the problem in height and weight. The work of Boas, Burk, and Wiener is especially emphasized and the more general and interrelated problems of development are treated in a scholarly and helpful manner.

341. HALL, W. S. Changes in the Proportions of the Human Body During the Period of Growth. *J. Anthropol. Inst. of Gr. Brit. & Ire.*, 1895, (25), 21-46.

A study in growth in height of boys in Friends' schools and Haverford College ranging from 9 to 23 years of age. Many other measurements are included and some conclusions in regard to strength. There was a great homogeneity of race, nationality, and social conditions among the individuals in these schools.

*342. HALL, MRS. W. S. The First Five Hunderd Days of a Child's Life. *Child Study*, 1896-97, (2), 332-342.

Continuous measurements (25 items) of an infant at 1-12, at 15 and at 18 months. Two tables and 1 graph show that periods of accelerated growth in one dimension alternate with periods of accelerated growth in the other dimensions and that the weight varies as the product of the vertical and lateral dimensions.

*343. HAMMETT, F. S. AND MCNEILE, L. G. Concerning the Effect of Ingested Placenta on the Growth-promoting Properties of Human Milk. *Science*, N. S., 1917, (46), 345-346.

Shows the effect of the mother's ingestion of dessicated placenta in hastening the infant's recovery from the post-natal decline in weight.

*344. HAMMETT, F. S. The Relation between Growth Capacity and Weight at Birth. *Amer. J. Physiol.*, 1918, (45), 396-405.

Data are given in five tables on weight of 537 breast-fed infants of Boston, 1, 3, 5, 7, 9, 11 and 13 days after birth. The post-natal decline in weight is shown to be a function of birth weight and growth capacity to be inversely proportional to initial weight. The article contains a discussion of the factors that influence growth.

345. HANNA, D. *Anthropometric Tables Compiled from the Measurements of 1600 Women* (Oberlin students). Oberlin, O.: Dep. of Phys. Training, 1893.

An elaborate series of tables showing many comparative measurements.

346. HANSEN, S. Über die Individuellen Variationen der Körperproportionen. *Arch. f. Anthropol.*, 1891-92, (20), 321-323.

This investigation is based on 2883 cases and gives the results, in tabular and graphic form, of the relation of the length of the foot to the height of the body.

347. HANSEN, S. Om Legemsvekst og Legemshöide. *Medd. om Danmarks anthropologi,* 1907-11, (1), 205.

348. HARRINGTON, T. F. Health & Education. *Amer. Phys. Educ. Rev.,* 1910, (15), 373-388.
Contains, after a discussion on health and ventilation, a study of the weight of 763 boys and 653 girls born in Boston, whose parents were born in Boston and attended the same schools from which Bowditch secured his measurements in 1876. At the present stage of this investigation the boys are slightly lighter than those of 1876, except at 13 years of age, and the girls are heavier.

349. HARRIS, J. Decrease in Stature; Note on Medico-Actuarial Mortality Investigation. *Amer. Statis. Ass'n.,* 1920, (17), 219-221.
An analysis of data on 182,290 men and 125,016 women compiled and published by the Association of Life Insurance Medical Directors and the Actuarial Society of America, New York: 1912 (1).

350. HARTWELL, E. M. Preliminary Report on Anthropometry in the United States With Provisional List of Works Relating to Anthropometry in the United States. *Amer. Statis. Ass'n.,* 1893, (3), 554-568.
A summary and references on the work in anthropometry in this country.

351. HARTWELL, E. M. Reports on Physical Training in Boston Public Schools. *Boston, Mass. School Report,* 1894-95, 181-260.
A careful study of the relation of stature to school work.

352. HARTWELL, E. M. Bowditch's Law of Growth and What it Teaches. *Amer. Ass'n. for the Adv. of Phys. Educ.,* 1896, 23-30.
Bowditch's law of growth is as follows: "There is a prepubertal acceleration of growth in height and weight, both in males and females, followed by a postpubertal retardation in such growth; and girls when growing most rapidly, exceed boys of like age, in height and weight." It has been thought that Bowditch was the first to note this, but it was previously noted by Fahrner, who measured 1789 children for desks.

353. HASSE, E. *Beiträge zur Geschichte und Statistik des Volksschulwesens von Gohlis.* Leipzig: Dunker und Humbolt, 1891.
Reprinted from *Report of the City of Leipzig,* 1889.

354. HASTINGS, W. W. Brief Resumé of Quetelet's Treatise on Man. *Amer. Phys. Educ. Rev.,* 1898, (3), 258-269; 309-318; 366-376.
A good summary of this book, which is anthropological rather than anthropometrical in its content.

355. HASTINGS, W. W. Anthropometry Studies in Nebraska. *Amer. Phys. Educ. Rev.,* 1900, (5), 53-66. Also *J. of Nat. Educ. Ass'n. of U. S.,* 1899, 1076-1084.
In this investigation 15 measurements were made on 2500 public school children of Nebraska. Conclusions are given as to comparative weights of boys and girls, physical well-being and mental efficiency, height and nationality. Tables are given showing average height and weight, for boys and girls, for different ages and different grades.

356. HASTINGS, W. W. *A Manual for Physical Measurements.* New York: Macmillan Co., 1902. Pp. 112.
The best summary from an anthropometrical standpoint so far published. A large amount of comparative material has been

included and many practical suggestions given. A good list of references is appended.

357. HASTINGS, W. W. Health and Growth of School Children. *J. Nat. Educ. Ass'n of the U. S.*, 1903, 769-795.
A summary which first takes up the methods of ascertaining the normal periodic increase of growth, and secondly, the practical methods of comparing the individual child with this known standard.

358. HATTA, M. *Intellectual and Physical Development.* Tokyo: Maruzen Co. No date.
The 786 graduates of a Japanese "middle school" were classified in 10 grades according to examination marks. The brighter boys were found to be superior in physical development.

359 HAUSTEIN, H. Die Darstellung von Mensch und Tier durch Messung, Messchema und Zeichnung. *Zsch. f. Ethnol.*, 1916, (48), 51-62.

*360. HAVERSCHMIDT, J. Over voedeldoseering en lichaamsgewicht bij zuigelingen. *Nederl. Tijdschr. v. Geneesk.*, 1917, (1), 1323-1326.

*361. HECKER,— Über Gewicht und Länge der Neugeborenen Kinder im Verhältnis zum Alter der Mutter. *Monatsch. f. Geburtsk.*, 1865, (26).

*362. HECKER,— (Birth Measurements of Infants) *Monatsch. f. Geburtsk. u. Frauenkrankh.*, 1866, (27), 286.
Reports length of München infants.

*363. HEIDEMANN,— *Über Gewichtsschwankungen Neugeborener. Diss.* Heidelberg, 1910.

364. HELLER, R. Untersuchungen über die Wachstumsverhältnisse der männlichen Jugend in Salzburg. *Internat. Arch. f. Schulhyg.*, 1913-14, (9), 377-388.
Investigations made upon 2400 pupils in various kinds of schools show a wide diversity of growth conditions. Children who had taken part in school outings or had spent a month in a country home were found to be much improved physically.

365. HENSEN, V. Das Wachstum. *Hermann's Handb. d. Physiol.*, Leipzig: 1881, (6), Part 2, 259-269.
A general treatise on growth with numerous tables from Quetelet.

366. HERGEL, G. Was ist auf den Gebiete der körperlichen Ausbildung unserer Mittelschuljugend Erreichbar? *Zsch. f. Schulgesundheitspfl.*, 1897, (10), 333-334.
A brief discussion leading to other papers on physical training.

*367. HERMAN, C. One Hundred Infants Followed from Birth to the End of the First Year. *Arch. of Pediat.*, 1913, (30), 97-110.
Eight curves show the effect of various feeding conditions of individual infants during the first year. No average growth charts.

368. HERTEL, A. *Report of the Danish Commission.* 1882.
This report takes up age, length of work, time at home and school, height, weight, and the common diseases, and a comparison is made between the pupils in the higher and in the Volkschulen. 17,595 boys and 11,646 girls were included, both in Copenhagen and in the country.

369. HERTEL, A. *Overpressure in High Schools of Denmark.* Tr. by Godfrey Sorenson. New York: Macmillan Co., 1885.
This is an English translation of Hertel's book which discusses the question of growth and prevalence of chronic diseases among children of different ages.

370. HERTEL, A. Neuere Untersuchungen über den allgemeinen Gesundheitszustand der Schüler und Schülerinnen. *Zsch. f. Schulgesundheitspfl.*, 1888, (1), 167-183; 201-215.

A comparison is made between age, height, and diseases of children betwen the ages of six and 17 as shown by Hertel's report, a report of the Danish Commission and a report of the Swedish commission. The emphasis in the article is placed on the relation of disease to physiological growth.

371. HERTZ,— Köbenhavnske Kommuneskolebörns Vekstforhold. *Medd. Danm. Anthrop.*, 1907-11, (1).

372. HERZOG,— Das Gewicht unserer Kriegskinder. *Kinder-Arzt*, 1916, (27), 167-169.

Comparing the years 1912 and 1915-16, the author finds that in 1912 56.09% of the cases exceeded the average weight of their age, while in 1915-16 58.02% did so. War children were also better developed all during the first year. The author thinks this is due to social hygiene.

*373. HESS, A. F. Infantile Scurvy. *Amer. J. Dis. Child.*, 1917, (14), 98-109.

Nine charts show weight in various conditions of the disease with various antiscorbutic diets. Other articles along this line in *J. Amer. Med. Ass'n.*, 1915, (75), 1003; *Amer. J. Dis. Child.*, 1916, (12), 152.

*374. HESS, W. Bestimmungen des Gewichtes und Messungen der Körperlänge bei einem Kinde im ersten und zweiten Lebensjahre. *Arch. f. Gynäk.*, 1881, (17), 150-152.

This consists merely of a table of weights (weekly, in most cases). Only a few determinations of height were made.

*375. HEUBNER, O. Wachstum des Kindes. In *Lehrb. d. Kinderheilk.* Leipzig: Barth, 1911, (1), 1-12.

This is a general treatise on growth with several tables of norms from Camerer and other writers.

*376. HILLENBERG,— Betrachungen über den Einfluss der natürlichen und künstlichen Ernährung auf die körperliche Entwicklung der Säuglinge im Stadt- und Landkreis Zeitz. *Zsch. f. Säuglingsfürsorge*, 1912-13, (6), 157-169.

No very significant differences in the development of breast fed and bottle fed children were observed. Whatever advantage there is is on the side of the breast fed children in the city and the bottle fed in the country, where breast fed children are apt to be irregularly fed because their mothers are working in the fields.

*377. HIRSCH,— Die "physiologische" Gewichtsabnahme der Neugeborenen. *Berl. klin. Woch.*, 1910, 11.

378. HITCHCOCK, E. The Need of Anthropometry. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1887, (3), 3-8.

A discussion of the history of anthropometry, together with suggestions on how to take measurements accurately.

379. HITCHCOCK, E. Physical Measurements; Fallacies and Errors. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1887, (3), 35-42.

Hitchcock reaches the conclusion in this discussion that "human measures increase with height, always understanding that the law will not include some of the tests of strength." A criticism of the Hemenway charts is also included.

380. HITCHCOCK, E. (a). *Anthropometrical Data Based upon Nearly 3000 Measurements Taken from Students.* Amherst: 1888.

Included in program of exhibition of physical exercises (a, b, c, d, e).

381. Hitchcock, E. (b). *Average and Mean Anthropometric Data of Amherst College Students.* Amherst: 1888.
A series of elaborate tables.

382. Hitchcock, E. (c). *The Gain in Physical Strength of College Students.* Amherst: 1892.
Two tables.

383. Hitchcock, E. (d). *Physical Growth of Amherst Students.* Gain between Freshman and Senior Years. Amherst: 1892.

384. Hitchcock, E. (e). *The Distribution of Physical Measurements Shown in the Different Years of College Life.* Amherst: 1892.

385. Hitchcock, E. A Synoptic Exhibit of 15,000 Physical Examinations. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1890, (5).

386. Hitchcock, E. Comparative Study of Measurements of Male and Female Students at Amherst, Mt. Holyoke & Wellesley Colleges. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1891, (6), 37-42.
A discussion of Bowditch's paper on percentile grades, accompanied by three tables. The first table gives the average measurements of 2000 students; the second, the means rather than the averages for 2086 students; and the third, the average measurements of 326 college men between 21 and 22 years of age.

387. Hitchcock, E. *The Results of Anthropometry as Derived from the Measurements of the Students in Amherst College.* Amherst, Mass.: Carpenter & Morehouse, 1892. Pp. 7.
This consists principally of six tables (50 items) of measurements for students 16 to 26 years of age.

388. Hitchcock, E. Anthropometric Statistics of the Students of Amherst College. *Amer. Statis. Ass'n.* (quarterly), 1893, (3), 588-599.
A summary of the statistical work of the department of physical education.

389. Hitchcock, E. and Anderson, W. G. Report of the Committee on Statistics Appointed by the Association in 1885. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1888.
A comprehensive summary of what measurements should be taken and how it should be done, including detailed methods, tests, and a discussion of the conditions of the body.

390. Hitchcock, E., Seeley, H. H. and Phillips, P. C. *The Anthropometrical Manual of Amherst College.* Amherst, Mass.: Carpenter & Morehouse, 1900. Pp. 40.
This is one of the early manuals with directions for making measurements and tables of norms for 53 measurements, arranged to show the average, etc.

391. Hoffman, F. L. *Army Anthropometry and Medical Rejection Statistics.* Newark, N. J.: The Prudential Press, 1918. Pp. 114.
A preliminary study of "rejection data."

*392. Hoffmann,— Diss. Rostock: 1918.
Data are given to show that war babies are not physically inferior to those born previous to war times as Kettner claimed in 1916.

*393. Hofmann,— Über die Gewichtszu- und Abnahme neugeborner Kinder. *Neue Zsch. f. Geburtsk.*, 1849, (27), 146-148.
The weights of 36 children were taken daily for five days and for some of the children the weighing extended to the 18th day.

394. Holmes, B. A Study of the Growth of Children, being a Review of the Work of Dr. Wm. T. Porter of St. Louis. *N. Y. Med. J.* 1894, (60), 417-423.
A critical discussion of Porter's work.

395. HOLMGREN,— Einfluss der Basedowsche Krankheit auf das Längenwachstum. *Nord. med. Archiv*, 1909 og 1910.

*396. HOLT, L. E. *The Diseases of Infancy and Childhood.* New York: D. Appleton, 1916. Pp. 1180.

Contains a chapter on Growth and Development with weight charts, and tables of measurements taken from other authorities. No data are given for the author's own weight chart in this edition. The 1920 edition by Holt and Howland contains norms at six month intervals from birth to four years.

397. HOLT, L. E. Standards for Growth and Nutrition. *Amer. J. Dis. Child.* 1918, (16), 359-375. Also *Trans. Amer. Pediat. Soc.*, 1918, (30), 73-92.

A good review of the principal investigations in this field with graphs showing the scattered distribution of records for any age, height or weight, which makes the fixing of standards of growth very difficult. Some new data on 350 boys from the Browning School of New York City are given in a graph.

398. v. HÖSSLIN, H. Über die Ursache der scheinbaren Abhängigkeit des Umsatzes von der Grösse der Körperoberfläche. *Arch. f. Anat. u. Physiol.*, (Physiol. Abteilg.), 1888.

399. HOWARD, F. G. War Bread and Growth of Children. *Medical Officer*, Jan. 11, 1919.

*400. HOWLAND,— AND DANA,— A Formula for the Determination of the Surface Area of Infants. *Amer. J. Dis. Child.*, 1913, (6), 33.

401. HRDLIČKA, A. Physical Differences Between White and Colored Children. *Amer. Anthropol.*, 1898, (11), 347-350.

Colored children are found to be less variable, taller, lighter in weight and smaller in head circumference.

402. HRDLIČKA, A. *Report on Anthropological Work in the State Institution for Feeble-Minded Children.* New York: Wynkoop, Hallenbeck, Crawford Co., 1899. Pp. 98. See also *J. Psycho-Asthen.*, 1898-99, (3), 47-75.

403. HRDLIČKA, A. Anthropological Investigations on 1000 White and Colored Children of Both Sexes. *47th Ann. Rep., New York Juvenile Asylum.* New York: Hallenbeck Crawford Co., (state printers), 1899, (47), 1-86.

The author finds these children in general somewhat inferior to healthy children from good homes but attributes it in most cases to neglect and improper nutrition. The report contains the results of much painstaking anthropometrical research and a discussion on the unreliability of the "stigmata of degeneration."

404. HRDLIČKA, A. *Physiological and Medical Observations among the Indians of the South West United States and New Mexico.* Washington: Gov. Print. Off., 1908. Pp. 460.

Contains extensive studies of the Indian child.

405. HRDLIČKA, A. Physical Anthropology, its Scope and Aim, its History and Present Status in America. *Amer. J. Phys. Anthropol.*, 1918, (1), 133-182; 267-304; 377-414. Rev. Ed., Philadelphia: Wistar Institute, 1919.

This is a complete historical review with references to the works of American investigators on physical anthropology.

406. HRDLIČKA, A. Anthropometry of the Living. *Amer. J. Phys. Anthropol.*, 1919-20.

Directions for making measurements according to modern technique.

407. HULTKRANTZ, J. V. Über die Körperlänge der Schwedischen Wehrpflichtigen. *Centralbl. f. Anthropol.*, 1896, (1), 289-291.

408. Hurd, K. C. Some of the Francis Galton Tests Concerning the Origin of the Human Faculty. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1891, (6), 80-96.

An application of Galton's measurements to Bryn Mawr schools and Bryn Mawr College, including some anthropometric measurements.

409. Hutchinson, J. On the Capacity of the Lungs and on the Respiratory Functions, etc. *Med. Chir. Trans.*, 1846, (29), 137-252.

A good pioneer study in lung capacity.

410. Ichak, F. and Friedenthal, H. Über graphische Darstellung von Wachstumserscheinungen. *Arbeiten aus dem Gebiet der experimentellen Physiologie.* Jena: Fischer, 1911, (2), 281-286.

*411. Ingerslev,— (Birth Measurements of Infants) *Nord. med. Arch.*, 1875, (7), No. 7. Also *Obstet. J. of Gr. Brit. and Irel.*, 1876, (3), 705.

Measurements of 3450 infants gave an average weight of 3333.5 grams. An increase of weight was noted from the 1st to the 5th pregnancy. Of interest chiefly because it reports an early experiment to determine causes of loss.

412. Ireland, M. W., Love, A. G. and Davenport, C. B. *Physical Examination of the First Million Draft Recruits.* (War Dep. Off. of the Surg. Gen., Bull. No. 11). Washington: Gov. Print. Off., 1919. Pp. 521.

The results of the physical examination of men sent to mobilization camps are exhaustively analyzed in many tables and graphs to show the incidence of defect in various states, in rural and urban districts, etc.

*413. Issmer,— (Birth Measurements of Infants). *Arch. f. Gynäk.*, 1899, (30), 277.

Issmer measured 7612 infants in Dresden and Munich and found their average weight to be 3267 grams and their average height 50.3 cm. He found that these measurements increased with the age of the mother and the number of the pregnancy.

*414. Jackson, C. M. Growth of the Embryo. *Amer. J. of Anat.*, 1909, (9), 119-165.

A good presentation of the facts of growth discovered as a result of measurement of specimens.

415. Jackson, W. A., Jr. Tables of the Anthropometric Measurements of the Williston Seminary Students. *The Willistonian*, Easthampton, Mass., 1892. Pp. 140.

416. Jackson, W. A., Jr. Graphic Methods in Anthropometry. *Phys. Educ.*, 1893, (2), 89-94.

Diagrammatic charts on physical growth and proportions of different parts of the body.

*417. Jaschke,— Neue Beiträge zur Physiologie und Technik der natürlichen Ernährung der Neugeborenen. *Zsch. f. Geburtsh. u. Gynäk.*, 1913, (74), 494-541.

This article is mostly concerned with nutrition, but includes a number of curves showing the effect of diet on weight.

418. Jeanneret, L. and Messerli, F. Un nouveau mode de contrôle de la croissance de l'enfant. *Rev. Méd. de la Suisse Rom.*, 1917, (37), 570-573.

Discusses the "photo-anthropometrique" method of registering the growth of a child.

*419. Judson, C. F. and Gittings, J. C. *The Artificial Feeding of In-*
This is a general treatise with a chapter on the Weight and
fants. Philadelphia: Lippincott, 1902. Pp. 368.

Growth of the infant, containing tables and graphs from the principal investigators.

420. KAISER, H. Das Wachstumsgesetz. PFLÜGER'S *Arch. f. d. ges. Physiol.*, 1875, (11), 610-624.
This consists purely of the mathematical derivation of a growth formula without observational material.

421. KARNIKKI, A. O. (Law of Periodicity in the Increase of Weight in Children.) *Vrach. Gaz.*, 1903, (13), 47-50.
Russian.

*422. KARNITZKY, A. C. Zur Physiologie des Wachstums und der Entwicklung des kindlichen Organismus. *Jahrb. f. Kinderheilk.*, 1908, (68), 462-474.
This is a plea for individual study including blood tests as well as the usual measurements of physical growth. Preliminary results are given for one child, showing that the normal healthy child loses weight during the first days of life, regains the birth weight at 10 days, and gains steadily thereafter (if breast fed) contrary to the opinion of other investigators who find sporadic periods of no increase.

*423. KASTNER, O. Körpervolumen und specifisches Gewicht von Säuglingen. *Zsch. f. Kinderheilk.*, 1911-12, (3), 391-412.
Contains measurements on 154 living infants and good references.

424. KAY, T. Tables Showing Height, Weight, Mental Capacity, Condition of Nutrition, Teeth, etc. (of Glasgow School Children). *J. Roy. San. Inst.*, 1904-05, (26), 907-913.

425. KELLOGG, J. H. *Outline Studies of the Human Figure*, (comprising 118 figures which embody the results of several thousand observations, embracing studies of a number of different civilized and uncivilized races.) Chicago, Battle Creek, Mich.: Mod. Med. Pub. Co., 1893.

426. KELLOGG, J. H. The Value of Strength Tests in the Prescription of Exercise, and a Comparative Study of the Strength of Individual Groups of Muscles, and of Homologous Muscles of Men and Women. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 49-75.
Many physical measurements of different parts of the body are included.

427. KERR, J. Standard Measures of School Children. *School Hygiene*, 1918, (9), 4-15.
Discusses seasonal variations and the value of physical training. Measures of height and weight for ages six to 17 are reported somewhat dogmatically as final standards.

428. KERR, J. Standard Measurements for School Children. *Mind and Body*, 1919, (26), No. 281, 193-212. Reprinted from *Amer. J. of Sch. Hyg.*
A review of recent work with a few tables and graphs. The writer mentions a number of investigations not usually referred to in the literature.

429. KETTNER, A. H. Das erste Kriegsjahr und die grossstädtische Volksschulkinder. *Dtsch. med. Woch.*, 1915, (41), 1428-1430.
This contains four charts showing the percentile distribution of increments for height of nine year old boys, weight of 11 year old boys, weight of 10 year old girls, and height of 12 year old girls in 1913-14 and 1914-15. The war curves are all shifted toward the end of the scale representing smaller amounts of increment, that is, fewer children show large increments and many more smaller increments.

430. KEY, A. *Läroverkskomiténs betänkande III Bilage E.* Stockholm: Kongl. boktryckeriet, 1885.

Edited in German by Bürgerstein. *Schulhygienische Untersuchungen,* Hamburg, 1889.

A report of the Swedish commission of which Key was appointed chairman in 1882. About 15,000 boys and 3000 girls were examined. Most of the book is concerned with hygienic investigations and an important contribution is made bearing on the relation of disease to nodes of growth. The study of the height and weight extends from the age of six to 20 years.

431. KEY, A. *Schulhygienische Untersuchungen.* Leipzig und Hamburg: Bürgerstein, 1889. Pp. 346.

Key found in Sweden that liability to sickness decreases with increasing rate of growth, and increases with decreasing rate of growth; therefore, one may be taken as the measure of the other.

432. KEY, A. *Die Pubertätsentwicklung und das Verhältnis derselben zu den Krankheitserscheinungen der Schuljugend.* Reprinted from *Proc. of the 10th Internat. Cong. of Med.,* 1890, (1), 66-130.

433. KEY, A. Pubertetsutvecklingen och Sjukligheten hos Skoleungdomen. *Nord. med. Archiv.,* 1891.

*434. KÉZMARSKY, T. Über die Gewichtsveränderungen reifer Neugeborener. *Arch. f. Gynäk.,* 1873, (5), 547-561.

The weights of 73 children are reported and the usual conclusions drawn in regard to the factors entering into the physiological loss of weight.

*435. KÉZMARSKY, T. (Birth Measurements of Infants) *Mittheil, a. d. geburtsh. u. gynäk. Klin. in Budapest über d. Jahre 1874-82.* 1884.

436. KIMPFLIN, G. Les lois de la croissance physique pendant l'enfance et l'adolescence. *Compt. rend. de acad. d. sci. de Paris,* 1914, (158), 801-803.

Measurements are reported for the height and weight of 200 children 11 to 16 years. The writer observed that from 11 to 14, growth in height was particularly active and from 14 to 16 growth in weight. Values reported here are higher than the averages of Quetelet, Variot and Chaumet, Godin, and other French investigators.

*437. KING, I. Measurements of the Physical Development of Two Children. *J. of Educ. Psychol.,* 1910, (1), 279-286.

An important individual study of the author's two boys, one between the ages of birth and six years, and the other for the first three years. 14 measurements besides height and weight are included.

438. KIRCHHOFF, A. Zur Statistik der Körpergrösse in dem Saalkreise zu Halle und dem Mansfelder Seekreise. *Arch. f. Anthropol.,* 1892-93, (21), 133-143.

In this investigation, which was carried on in 1882, Kirchhoff makes some very interesting comparisons. 2637 measurements were made in the Saalkreis and 2812 in the Seekreis.

439. KIRKOFF, N. Recherches anthropologiques sur la croissance des élèves de l'École militaire de S. A. R. de Prince de Bulgarie, à Sofia. *Bull. et mém. de soc. d'anthrop. de Paris,* 1906, 5 s. (7), 226-233.

440. KIRKPATRICK, E. A. Physical Growth and Development. In *Fundamentals of Child Study.* New York: Macmillan Co., 1917, 32-46.

A brief but suggestive discussion on the general problem of growth.

*441. KIRSTEIN, F. Über die physiologische Gewichtsabnahme Neugeborener. *München med. Woch.*, 1917, (64), 1178.

*442. KIRSTEIN, F. Über die physiologische Gewichtsabnahme Neugeborener. *Zsch. f. Geburtsh. u. Gynäk.*, 1917-18, (80), 448-465.

*443. KJÖLSETH, M. Untersuchung über die Reifezeichen des neugeborenen Kindes. *Monatsch. f. Geburtsh. u. Gynäk.*, 1913, (38), 216-298.

A careful study of five measurements and other characteristics of infants born seven to nine months after conception. Reference list of 96 numbers.

444. KNOOP, L. Zum Index aus Körperhöhe und Armspannung. *Kor. Bl. d. dtsch. Gesellsch. f. Anthropol.*, 1918, (49), 26.

445. KOCH-HESSE, A. Ein Beitrag zur Wachstumsphysiologie des Menschen. *Zsch. f. Schulgesundheitspf.*, 1905, (18).

This study is of special importance for its table of height and weight of children (about 12 years of age), arranged according to nationality and economic condition of the parents. This table is a compilation of the results of 26 different investigations in various parts of the world. A similar table is given for children of about 14 years of age.

*446. KÖRBER,— (Birth Measurements of Infants). *Vierteljahrsch. f. gerichtl. Med.*, 1884, n. F. (40), 225.

Reports the length of 2495 St. Petersburg foundlings and 5528 Moscow foundlings.

447. KOREN, A. Die Körperlänge norwegischer Soldaten. *Kor. Bl. d. dtsch. Gesellsch. f. Anthropol.*, 1901, (32), 46.

448. KOSMOWSKI, W. Über Gewicht und Wuchs der Kinder der Armen in Warschau. *Jahrb. f. Kinderheilk.*, 1894, (39), 70-76.

This is a study of the measurements of 1540 boys and 1898 girls 8-15 years of age (not successive measurements). These children were measured in Ferien-Kolonien and in the author's general practice. Many comparative tables are included.

449. KOTELMANN, K. Der Körperverhältnisse der Gelehrtenschüler des Johanneums in Hamburg. *Zsch. d. kgl. preusz. statist. Bur.*, 1879, (19), 1-16.

This article shows the effect of school conditions, especially in the secondary school, where physical training was given, to be very beneficial. Height, weight and lung capacity of 115 boys from 10 to 15 years are reported.

450. KÖTZ, A. Wachstumssteigerung einer Körperhälfte im Kindesalter. *Monatschr. f. Kinderheilk.*, 1918-19, (15), Orig., 389-396.

*451. KRÜGER, G. Über die zur Nahrung Neugeborener erforderlichen Milchmengen mit Rücksicht auf die Gewichtsveränderungen der Kinder. *Arch. f. Gynäk.*, 1875, (7), 59-106.

Fairly complete records on 12 cases followed for about 12 days, showing fluctuations in weight, together with other data.

452. KUBO, T. Rassenanatomische Untersuchungen an Chinesen. *Mitt. a. d. Med. Fakult. d. k. Univ. zu Tokyo*, 1912, (14), 37-57; 1915, (17), 345, 373, 401.

453. KUBO, T. Physical Anthropological Study of the Korean People. *China Med. J.*, 1917, (31), 523-550.

454. KUBO, J. Korean Stature and Weight Compared According to Provinces. *Chosen Igakukai Zasshi.* No. 19, Transl. and abstr., *China Med. J.*, 1918, (32), 566.

455. KULKA, W. Studien zur Wachstumsphysiologie an den Zöglingen einer militärischen Erziehungsanstalt. *Österr. San-Wes.*, 1912, (24) 1365-1383.

Tables are given for growth in height, weight and chest circumference.

456. LANDSBERGER,— Das Wachstum der Knaben vom 6 bis zum 13 Lebensjahre. *Zsch. f. Schulgesundheitspf.*, 1888, (1), 65-69.

An important investigation based on consecutive measurements of 37 children between the ages of six and 13. Many other measurements are included and a comparison is made with the work of Bowditch and other investigators.

457. LANDSBERGER,— Das Wachstum im Alter der Schulpflicht. *Arch. f. Anthropol.*, 1888, (17), 229-265.

This is an important detailed study of boys six to 13 years of age, including six yearly determinations of 22 measurements on 37 to 104 individuals (nude). The data are arranged for comparison between rich and poor, German and Polish. Comparisons are made with the material of other investigators.

458. LANE, W. A. Some of the Laws which Influence the Growth of Children. *Proc. Internat. Cong. Hyg.*, London: 1892, 103-109.

A general discussion.

459. v. LANGE, E. *Die normale Körpergrösse des Menschen von der Geburt bis zum 25 Lebensjahre.* München: Lehmann, 1896.

This is a résumé, without specific references, of previous work. Comparative tables are included but the curves constructed from there are too much smoothed to be really useful.

460. v. LANGE, E. Die Gesetzmässigkeit im Längenwachstum des Menschen. *Jahrb. f. Kinderheilk.*, 1903, (57), 261-324.

This study is based on the writer's work from 1890 onward, with some new data. His aim is to discover the laws of growth. With this end in view, he has subjected to mathematical treatment a large amount of material of his own and of other investigators and constructed ideal curves from birth to 20 years of age. All these curves are smoothed in such a way as to give the impression that growth goes on in a perfectly uniform fashion.

*461. LANGE-NIELSEN, C. (The Weight and Length of New-born Infants in Norway). *Norsk. Mag. f. Laegevidensk.* Kristiania: 1918, (79), 1134-1145.

Birth weight and length of about 1100 Norwegian infants are studied. Both measurements are found to increase with the age of the mother and with the serial order of the pregnancy. Norwegian infants are found to be heavier and longer than German or Danish infants.

*462. LANGSTEIN, L. Hunger und Unterernährung im Säuglingsalter. *Jahreskurse f. ärztl. Fortb.*, 1912.

*463. LANGSTEIN, L. AND MEYER, L. F. *Säuglingsernährung und Säuglingsstoffwechsel.* Wiesbaden: Bergmann, 1914. Pp. 408.

This is a general text on nutrition with a section *Die physiologische Entwicklung des Säuglings.*

*464. LASCOUX, P. *Etude sur l'accroissement du poids et de la taille des nourrisons.* Diss. Paris: Michalon, 1908.

465. LASSABLIÉRE,— Évaluation de la surface cutanée chez le jeune enfant. *Compt. rend. soc. de biol.*, 1910, 339.

466. LAUMONIER, J. Les proportions normales du corps chez les enfants. *Corresp. méd.*, 1909, (16), No. 351, 16.

467. LAURENT, A. Les lois de la croissance et l'éducation physique. *Méd. inf.*, 1894, (1), 619; 667.

468. LEE, A. AND P. K. Data for the Problem of Evolution of Man. *Philos. Trans. Roy. Soc.*, 1901, (196), 225-264. Ser. A.
A good treatment of the general problem of physical development.

469. LEE, A., LEWENZ, M. A., AND PEARSON, K. On the Correlation of the Mental and Physical Characters in Man. *Proc. Roy. Soc.*, 1903-04, (71-72), 106-114.
Further analysis of the Cambridge University material, leading to the conclusion that the correlations of intelligence with the ratios of length and breadth of head to stature are slightly smaller than the correlations of intelligence with the absolute head-measurements. Correlations are also given for intelligence with strength of pull, sight, weight, weight per inch of stature, and athletic ability.

470. LENTZ, E. Physiologische Schwankungen im Jugendalter und ihr Einfluss auf die geistige Arbeit. *Zsch. f. päd. Psychol.*, 1917, Part 1 and 2, 23-40.
Previous work in this field up to 1917 is outlined. Taking school attendance as an index of general health (after Lobsien), the records of 300 Gymnasium children and 950 elementary school children were analyzed. It appeared that the months of April-May, and of September-October, were best for general health, while November and December were worst. Psycho-pedagogical recommendations were made with reference to examinations, school marks, vacations, etc.

471. LESHAFT,— (Materials for the Study of the Years of School Life.) *Health*, 1879-80, 127-131.
Russian, cited by Sack.

*472. LETOURNEUR,— *De l'influence de la profession de la mére sur le poids de l'enfant.* Diss. Paris: 1897.

473. LÉVY, E., MAGNAN,— AND SELLET,— Relation entre la croissancė de la taille et le développment du périmètre thoracique chez l'homme. *Rev. prat. d'obst. et de paediat.*, 1914, (27), 13-21.

474. LIHARZIK, F. *Das Gesetz des menschlichen Wachstums.* Wien: Gerolds Sohn, 1858. Pp. 188.
A good pioneer study of measurements of the head and chest.

475. LIHARZIK, F. Der Bau und das Wachstum der Menschen. *Sitzungsber. d. königl. Akad. in Wien.* (Mathemat.- naturwissensch. Klasse), 1861, (44), Part 2.

476. LIHARZIK,— *Das Gesetz des Wachstums und der Bau des Menschen.* Vienna: 1862.

477. LINCOLN, D. F. Anthropometry Individualized. *Amer. Ass'n, for the Adv. of Phys. Educ.*, 1896, 4-11.
A practical paper with some very good observations on sexual maturity.

478. LIPIEC, M. Über das Wachstum der polnischen Jüdinnen. *Mitt. d. anthropol. Gesellsch. in Wien*, 1912, (42), 115-195; 281-334.
Measurements are reported for 340 girls 10 to 19 years of age. Thirteen measurements are recorded in full and studied absolutely and in comparison with the work of other investigators. The writer concludes that growth between these years comprises 20% of the total growth, that growth from 10 to 15 is fast, and from 15 to 19 slow, and that in the latter years growth in breadth is faster than in length. No pronounced corresponding change in indices was noted.

479. LIPIEC, M. Veränderungen in den kopfdimensionen bei Warschauer Jüdinnen. *Bull. intern. acad. d. sci. de Cracovie*, 1912, B., 633-648.

*480. Lissauer,— Über Oberflächenmessungen an Säuglingen. *Jahrb. f. Kinderheilk.*, 1903, (58), 392-411.

A good discussion of the development of formulae, together with references.

481. Livi, R. Saggio di antropometria militare. *Atti di Soc. rom. di antropol.*, 1894, (1), 292-307.

482. Livi, R. L'indice pondéral ou rapport entre la taille et le poids. *Archive ital. de Biol.*, 1899, (32), No. 2.

483. Lommel, F. Über den Einfluss des Kriegs auf den Ernährungszustand der Bevölkerung in Jena. *Berl. klin. Woch.*, 1916, (53), 293.

484. Lommel, F. Über den Einfluss der Kriegsmässig veränderten Ernährung. *Dtsch. med. Woch.*, 1916, (42), 351-353.

The weight of a large number of infants of the less favored classes was copied from the records of the Polyclinic. War conditions were found to have no influence on the growth of these infants. In fact the curves of the breast-fed and the artificially-fed were found to coincide with the normal curves of Camerer. For the years 13½ to 18½ the investigator used about 2000 weight determinations on over 50 employees of a firm in Jena. Practically the same individuals had been measured semi-annually for a number of years previous to the war. Comparison of the weights for each age group before and after 1915 and of the increments from one weighing to the next showed only a very slight difference in favor of the years before 1915. The investigator considers this difference quite unimportant.

485. v. d. Loo, C. J. Over lengte en gewicht van Kinderen in den leeftijd van 6-12 jaar. *Nederl. Tijdschr. v. Geneesk*, 1919, (20), 976-986.

*486. Lorey,— (On the Growth of Infants) *Jahrb. f. Kinderheilk.*, 1888, n. F., (27), 339.

For this article on physical growth the same material was used as that upon which Schmid-Monnard's work was based. (*Jahrb. f. Kinderheilk.*, 1892, (33), 327-350).

487. Lübsen, J. (State of Nourishment of Amsterdam School Children During the War). *Nederl. Tijdschr. v. Geneesk.*, 1917, (2), No. 21, 1865. Also *Nederl. Zsch. f. Heilk.*, Novbr. 24, 1917. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 579.

Height and weight of 3680 school children was recorded in January 1916. In January 1917, 5064 children were measured. No evil effect from war conditions was apparent. Lübsen cites similar investigations during the past two years in Germany.

488. Lucae, J. Ein Beitrag zum Wachsen des Kinderkopfes vom 3 bis 14 Lebensjahre. *Festsch. zur 13 Jahresversamml. d. dtsch. anthropol. Gesellsch.* Frankfurt a. M.: 1882.

*489. Lutz, R. Die körperliche Entwicklung des Neugeborenen. *Centralbl. f. Gynäk.*, 1912, (36), 1577-1581.

Height and weight of infants born after 28-44 weeks' pregnancy.

490. Macdonald, A. Experimental Study of Children. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1897-98, (1), 989-1204; (2), 1281-1390.

An extensive study of numerous physical and mental measurements of white and colored children in Washington. A number of comparisons of head measurements are made, and it is concluded that white girls have a greater standing height and sitting height than colored girls, but colored children have a greater weight than white children. Children of the laboring class are

superior in height, sitting height, and weight to those of the non-laboring class, which confirms the results of Roberts, Bowditch, and Baxter. Girls are superior to boys in their studies. Children with abnormalities are inferior in height, weight, and the other measurements included.

Many charts, tables and illustrations are given, and a list of references is appended.

491. MACDONALD, A. Man and Abnormal Man. 58th Congress, 3d Session, 1904-05, *U. S. Senate Documents* (9), No. 187. Pp. 780.

This is a reprint of six of the author's government publications including his *Experimental Study of School Children, Child Study in the United States, Statistics of Crime, Suicide and Insanity, and Insanity and Genius*, with many references.

492. MACDONALD, A. Beiträge zu der Entwicklung und der Entwicklungsfehlern der Kinder. *Jahrb. f. Kinderheilk.*, 1910, (71), 180-188.

In this article the author further examines statistics previously published under the title *Man and Abnormal Man*, and presents additional information in regard to head size and intelligence; cephalic index in puberty; abnormalities and defects in relation to sex, intelligence, nationality and social class; intellectual ability in relation to sex, nationality and social class; etc.

493. MACDONALD, A. Anthropometry of Civilized Man. *Med. Fortnightly*, 1919, (51), 61-65.

This consists mostly of conclusions drawn from the author's data published in *Man and Abnormal Man*.

494. MACKEPRANG,— De Vernepligtiges höide i Danmark. *Medd. Danm. Anthrop.*, 1907-11, (1, 2).

A study of the physique of men subject to military duty.

495. MACLAREN, A. *Physical Education*. Oxford: Clarendon Press, 1895. Pp. 462.

A plea for physical education with directions for exercising on pieces of apparatus that are illustrated. A table on page 438 shows the average height, weight, girth of chest, forearm and upper arm obtained from 100 boys at each age from 10 to 18 years.

496. MAKOWER, A. A. Untersuchungen über Wachstum. *Zsch. f. Schulgesundheitpfl.*, 1914, (27), 97-120.

Measurements are given for 400 Jewish children in Wilna, showing that there are no specific racial differences in growth, but a general increase in growth during vacation time, with a loss of weight during examination time. There is an apparent contradiction between these results and those of Schmid-Monnard (though he is not mentioned by Makower). Makower's weight increase during vacation seems to coincide with Schmid-Monnard's weight increase in August and September, during which the Russian summer vacation occurs. Both investigators are possibly proving the same general law.

497. MALLING-HANSEN, P. R. *Über Periodizität im Gewicht der Kinder.* Kopenhagen: 1883. Pp. 35.

Deals primarily with the seasonal and daily variations in growth due to climatic conditions.

498. MALLING-HANSEN, P. R. Einige Resultate der täglichen Wägungen von 130 Zöglingen des königlichen Taubstummeninstituts in Kopenhagen. *Congr. period. internat. d. sci. med.* Kopenhagen, (3), 103-119.

This is an address covering the subject of seasonal variations,

and a consideration of the effect of change of diet on growth in weight at different times of the year.

499. MALLING-HANSEN, R. *Perioden im Gewicht der Kinder und in der Sonnenwärme.* Kopenhagen: Tryde, 1886. Pp. 268.
This contains measurements of 130 boys and girls in an institution for the deaf and dumb. The author finds that variations in the weight of children are coincident with variations in the heat of the sun's rays, and draws rather fantastic conclusions from this coincidence.

500. MANOUVRIER, L. Étude sur les rapports anthropométriques en général et sur les principales proportions du corps. *Bull. et mém. soc. d'anthropol. de Paris,* 1902, 3 s., (2), 3-202.

*501. MARFAN, A. B. *Traité de l'Allaitement.* Paris: 1899 (1st ed.). Pp. 586.
Weight is mentioned briefly in connection with other physical signs of good feeding.

502. MARTIEGKA, H. Über die Beziehung zwischen Körperbeschaffenheit und geistiger Thätigkeit bei Schulkindern. *Mitt. d. anthropol. Gesellsch. in Wien,* 1898, n. F., (18), 122-126.

*503. MARTIN, C. (Birth Measurements of Infants.) *Monatschr. f. Geburtsk. u. Frauenkrankh.,* 1867, (30), 428.
Reports weight of Berlin infants.

504. MARTIN, E. L'anthropométrie appliquée à l'étude du développement des enfants anormaux. *L'enfance anorm.,* 1912, 417-425.

505. MARTIN, R. *Lehrbuch der Anthropologie.* Jena: 1914. Pp. 181.
Contains a discussion of racial differences in bodily proportions among much other important material.

506. MARTY, J. Recherches statistiques sur le développement physique des délinquants. *Arch. d. l'anthropol. crim.,* 1898, (8), 178-195.

507. MATTHIAS, E. *Der Einfluss der Leibesübungen auf das Körperwachstum.* Zürich: Rascher & Co., 1916. Abstract in *Zsch. f. Schulgesundheitspf.,* 1916, (29), 375-376.
Matthias investigated the effect of physical exercise on 737 Swiss athletes, 16-22 years of age, by means of the individualizing method. Each subject was measured three times a year. The conclusion was drawn that exercise greatly stimulates growth.

508. MATUSIEWICZ,— *Der Körperlängen-Körpergewichts-Index von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1914.

509. MATVEYEVA, V. G. (Physical Development of the Children of the St. Petersburg Public Schools). *Vrach.* 1895, (21), 918; 941.
Russian.

510. MAUREL, M. E. Adaptation de la section thoracique à la surface cutanée par rapport au poids depuis la naissance jusqu' à l'âge adulte. *Compt. rend. soc. biol.,* 1904, 980-981.

511. MAYET, L. La valeur moyenne du coefficient de robusticité chez les enfants de sept à treize ans d'apres 1250 observations et 5000 mensurations. *35 Congrès de l' A. F. A. S. C. R.,* 1906.

*512. MAYET, L. Le développement physique de l'enfant. *J. méd. franc.,* 1912, (6), 366-374.
This article is concerned with individual variations in weight and with the discussion of the "coefficient du robusticité."

513. MEAD, C. D. Height and Weight of Children in Relation to General Intelligence. *Ped. Sem.,* 1914, (2), 394-406.
Herein are reported measurements of 288 boys and 141 girls

of an Indiana institution. Five tables and five graphs are given which show that the degree of mental defect is closely correlated with the degree of physical defect.

514. MEEH, K. Oberflächenmessungen des menschlichen Körpers. *Zsch. f. Biol.*, 1879, (15), 425-458.
This contains formulae, comparative tables from other investigators, and drawings showing the regions of the body to be measured.

515. MEEH, K. Volummessungen des menschlichen Körpers und seiner einzelnen Theile in den verschiedenen Alterstufen. *Zsch. f. Biol.*, 1895, (31), 125-147.
This contains measurements of four cadavers and 10 living individuals, together with a review of previous work, tables of measurements, diagrams of the divisions of the body and charts to show the relationship of the volume of a single part of the body to the total volume in infant and adult life.

516. MEGRET, A. *Anthropométrie normale.* Paris: Laurens, 1895. Pp. 75.

517. MENARD, S. *Contribution à l'étude de la croissance chez l'homme et chez les animaux.* Paris: 1885.

518. MERESHOFFSKY, K. (On the Results and Methods of the Investigation of the Physical Development of Children.)
Russian, cited by Sack.

519. MERRINS, E. M. Anthropometry of Chinese Students. *China Med. J.*, 1910, (24), 318-324.
This contains measurements of the height and weight of 219 boys and 69 girls in the Wuchang schools for the ages 11 to 22. Chinese children are found to be lighter and shorter than certain American and English norms.

520. MERZ,— Recherches statistiques relatives à la valeur des indices numériques d'aptitude physique au service militaire. *J. de méd. et de chir. pratiq.*, 1901, (19), 211.

521. MEUMANN, E. *Vorlesungen zur Einführung in die Experimentelle Pädagogik.* Leipzig: Engelmann, 1911. Pp. 725.
The third part of this book contains a valuable chapter on growth. References are appended.

*522. MEYER, L. F. Über den Wasserbedarf des Säuglings. *Zsch. f. Kinderheilk.*, Orig., 1912, (5), 1-30.
This deals primarily with nutrition. There are a few graphs showing the effect of diet on weight.

523. MICHAILOFF,— (Materials for the Estimation of Physical Development and Disease in the Village School of Russik in the Province of Moscow.) *Fisitscheskoje raswitje utschastschichsja w selskich schkolach Rosny.* Moskau: 1887.
Found that children who are attending school are better developed than peasant children who are not going to school.

*524. MIES, J. (Birth Measurements of Infants) *Virchow's Archiv. f. d. path. Anat. u. Physiol.*, 1891, (123), 191.
Reports the length of 795 boys and 810 girls in a hospital in Köln.

525. MIES, J. Über die Masse, den Rauminhalt und die Dichte des Menschen. *Virchow's Arch. f. d. path. Anat. u. Physiol.*, 1899, (157), 90.

526. MILAÏLOW,— *(Report of the Municipal Council of Moskow)*, 1890.
Russian, cited by Wiazemsky.

*527. MILLER,— (Birth Measurements of Infants). *Jahrb. f. Kinderheilk. u. phys. Erziehung*, 1893, (36), 338.

Reports the birth measurements of foundlings in Moscow, including measurements of twins.

528. MISAWA, T. A Few Statistical Facts from Japan. *Ped. Sem.*, 1909, (16), 104-112.
In 1901 the Department of Education of Japan measured the heights and weights for 869,014 children. Misawa reports the results of this study in the above article.

529. MIWA, N. *A Study Upon Weight from 3 to 80 Years of Age.* Tokio: I-Gauk-Zwai-Zatumshi, 1893, (7), No. 9.
These measurements begin in the kindergarten and extend through the schools and to adults from other sources. A study of the effect of the weights in different classes of society is included, together with the problem of maturity. Also MIWA,— AND STOELTZNER,— Bemerkungen über die Bestimmung der Körperoberfläche des Menschen. *Zsch. f. Biol.*, 1898, (30), 314.

*530. MONTAGUE, H. AND HOLLINGWORTH, L. The Comparative Variability of the Sexes at Birth. *Amer. J. of Sociol.*, 1914, (20), 335-370.
Study of a series of physical measurements on two thousand infants measured in the New York Infirmary for Women and Children, the aim of the study being to determine, "Are males inherently more variable in anatomical traits than females?" The results show no inherent differences in anatomical variability.

531. MONTESSORI, M. *Pedagogical Anthropology.* New York: Stokes, 1913. Pp. 500.
A general exposition of the history and facts of anthropometry. As it is composed of lectures at the University of Rome, specific references are omitted.

532. MONTI, A. Das Wachstum des Kindes von der Geburt bis einschliesslich der Pubertät. *Wien. Klinik*, 1898, (24), 287-316. Also *Kinderheilk. in Einzeldarstell.*, Wien: 1898, Heft 6.
This consists of a lecture without specific references, but covering in considerable detail the contributions of various early investigators, and giving their tables, together with tables averaged from various sources. Weight, height, circumference of head and chest, body volume and surface, are included in the general discussion.

533. MOON, S. B. Measurements of the Boys of the McDonogh School for 1881-91. *McDonogh School*, Md.: 1892. Pp. 46.

534. MOON, S. B. The Growth of Boys. *Amer. Ass'n for the Adv. of Phys. Educ.*, 1896, 19-23.
A brief article giving the measurements in a percentile table for 150 boys who are measured annually from 11 to 15 years of age.

535. MOON, S. B. *The Growth of Boys.* Concord, N. H.; Repub. Press Ass'n. 1896. Pp. 9.
The 50 percentile boys, 11-15 years of age, are compared with Seaver's 50 percentile Yale man in 30 measurements. Two charts are given.

536. MOON, S. B. The Question of Growth at Puberty. *Amer. Phys. Educ. Rev.*, 1899, (4), 294-298.
Data are given with a view to testing Bowditch's law specifically in regard to retardation before pubescent acceleration. The law is not satisfactorily confirmed. It is concluded that "pubertal attainment has but little, if any, effect upon the rate of growth, at least in many cases."

537. MOORE, A. W. AND BEDDOE, J. Physical Anthropology of the Isle of Man. *J. Anthropol. Inst.*, 1897-98, (27), 104-130.

538. MOREY-ERRANT, D. Unity of the Periods of Growth in Man. *Trans. of Ill. Soc. f. Child Study,* 1898, (4), 84-91.
A general discussion bearing primarily on puberty.

*539. MORSE, W. H. The Baby's Growth. *Va. Med. Mo.,* 1886-87, (13), 392-395.
A brief study of the weight of infancy, showing the comparative stages of physical development.

540. MORSKOI, B. *Russian Naval Collections.* St. Petersburg: 1871, (12).
Contains the results of the physical examination of recruits in 1869 and 1870.

*541. MÜHLMANN, M. Über Wachstumserkrankungen. *Jahrb. f. Kinderheilk.,* 1910, (70), 174-208.
Remarks on diurnal fluctuations in weight. Eighteen individual charts from daily weighings of infants during the first seven to 11 days and in a few cases as far as 2½ months, with data on feeding, illness, etc., show fairly regular fluctuations in weight.

542. MULLER, G. Alphonse Bertillon's Method for the Identification of Criminals; Instructions For Taking Measurements and Descriptions. *Anthropometric Identifications,* 1887, (8), 84.
A practical guide for criminologists.

543. MUMFORD, A. A. Physique of the Modern Boy. *Manchester Lit. and Philos. Soc.,* 1912.
This deals with the development of Manchester grammar school children.

544. MÜNCH, L. Die Pirquet'sche Messtafel über Alter, Länge und Gewicht des Kindes. *Österr. San-Wes.,* 1914, (26), 1267-1269.
This contains two tables giving the height and the weight of children more than 3 cm. and more than 2 kgm. below the normal at each age.

545. MYERS, C. S. Contributions to Egyptian Anthropometry. The Comparative Anthropometry of the Most Ancient and Modern Inhabitants. *J. Anthropol. Inst.,* 1905, (35), 80-91.

546. MEYERS, C. S. Measurements of Egyptian Recruits. *J. Anthropol. Inst.,* 1906, (36), 237.

547. MYERS, C. S. Contributions to Egyptian Anthropology. *J. Roy. Anthropol. Inst. Gr. Brit. and Irel.,* 1908, (38), 99-147.

548. NAGORSKY,— *(The Influence of Schools on the Physical Development of Children.)* St. Petersburg: 1881.
Russian, cited by Sack.

549. NICEFORO, A. Note préliminaire d'anthropologie sur 3147 enfants des écoles de Lausanne étudiés en rapport à leur condition sociale. *Scuola positiva,* Roma: 1903, 2 s., (1), 257; 412.

550. NICOLAS, L. Historia de Anthropología Física en México. *Amer. J. Phys. Anthropol.,* 1919, (2), 229-264.

551. NIEUWENHUIS, A. W. *Anthropometrische Untersuchungen bei den Dajak.* Haarlem: Kohlbrugge, 1903. Pp. 20.

*552. NIKES,— *Abhängigkeit des Geburtsgewichtes der Neugeborenen vom Stand und der Beschäftigung der Mutter.* Diss. Strassburg: 1902.
Includes weight of infants measured 1896-1901.

553. NORSWORTHY, N. *The Psychology of Mentally Deficient Children.* Columbia Univ. Contrib. to Phil. and Psych. New York: Columbia Univ., 1906, (15), No. 2.
This is an extensive investigation of certain mental and physical traits in 138 feebleminded boys and girls. When the meas-

urements of height and weight were compared with the Boas and Bowditch standards for normal children, the feebleminded were found to be indistinguishable from ordinary children.

*554. ODIER,— *La loi d'accroissement des nouveau-nés.* Paris: 1863.

555. OEDER, G. Das Körpergewicht des erwachsenen Menschen bei normalem Ernährungszustand und seine Berechnung. *Zsch. f. Versicherungs-med.*, 1909, (2), 2-12; 33-41.

In this article Oeder develops a formula based on 2000 cases, in which body weight in kilograms is equal to body length in centimeters minus 100. Five graphs and an explanation of the exceptions to this rule complete the article.

556. OEDER, G. Über die Brauchbarkeit der proportionellen Körperlänge als Massstab für die Berechnung des Körpergewichts erwachsener Menschen bei normalem Ernährungszustand. *Med. Klin.*, 1909, (5), 460-465.

The subject matter of this, as of the other articles here referred to, is the discussion of the validity of the writer's formula. In this article he deals with 24 men and women and tries to define what is the normal condition of nutrition.

557. OEDER, G. Körpergewicht und Körperlänge. *Zsch. f. Versicherungs-med.*, 1910, (3), 138-141.

This is a more popular and briefer statement of the article in Vol. 2 of the same Zeitschrift. The formula is restated with the reservation that stature must be multiplied by twice the distance "vom Scheitel zur Symphysenmitte." With this reservation he finds his formula covers 98% of the male and practically all of the female cases.

558. OEDER, G. Körpergrösse und Körpergewicht des Menschen. *Dtsch. med. Woch.*, 1914, (40), 917-918.

This is principally a discussion of Schwiening's works.

559. OEDER, G. Die Gaertner'sche Normalgewichtstabelle für Erwachsene. *Berl. klin. Woch.*, 1915, 1086-1092.

A critical discussion of formulae for determining volume, specific gravity, etc. Comparative tables of 281 adults show the inadequacy of Gaertner's formula.

*560. OKAMATO, R. (Body Weight and Height of Japanese Babies). *Tokyo med. Woch.*, 1894, No. 839, 3-6.

561. OKER-BLOM,— Om Längd- och Viktförhallandena hos Eleverna vid Helsingfors Folkskolor. *Finska läk. händl.*, 1912, No. 1.

*562. OPITZ, H. (Growth and Development of Underweight New Born Children.) *Monatsch. f. Kinderheilk.*, 1914, (13), 3.

563. OPPENHEIM, N. *Development of the Child.* New York: Macmillan Co., 1898, 1-92.

A good general treatment of growth, without statistics or original measurements.

564. OPPENHEIMER, K. *Über die Wachstumsverhältnisse des Körpers und der Organe.* München: 1888.

*565. OPPENHEIMER, K. Über das Verhältnis des Nahrungsbedarfes zu Körpergewicht und Körperoberfläche bei Säuglingen. *Zsch. f. Biol.*, 1901, (42), 147-160.

This shows by 20 observations on three children, that the calculation of the nutritional requirements of infants should be based on surface measurements as well as on weight.

566. ORENSTEEN, M. M. Correlation of Anthropometrical Measurements in Cairo-born Natives. *Biometrika*, 1915-17, (11), Parts 1 and 2, 67-81.

Length and breadth of head, length of left middle finger,

length of left foot, length of left cubit are reported for 802 adult native Egyptians (prisoners). The coefficients of correlation between all parts measured are found to be significant.

*567. Orschansky,— *Die Vererbung im gesunden und kranken Zustande.* 1903, 157.

Reports the birth measurements of 171 boys and 178 girls of Charkow.

*568. Örum, H. P. T. *Vaegtsvingninger hos det spaede Barn.* Reprint from the *Nordisk Tidsskrift for Terapi*, 1914. Pp. 10.

This is an investigation of the growth in weight of 725 breast-fed children to establish normal weight curves for Danish infants. The author reviews earlier works on the weighing of infants, including many little known ones, but unfortunately gives no specific references. His weight curves are compared with those of Camerer. The author finds a seasonal variation in weight increase.

569. Örum, H. P. T. Om Vejning og Maaling af Skoleborn. *Tidsskrift for Dansk Skolehygiejne*, 1919, (7), No. 10, 77-82.

A thorough discussion of methods for the mathematical treatment of statistics of physical measurements, including an evaluation of the formulae of Livi, Pignet, von Pirquet and Rohrer.

570. Oschmann,— Der Einfluss der Kriegskost auf die Schulkinder. *Zsch. f. Schulgesundheitspf.*, 1917, (30), 49-59.

Measurements were made of 161 girls and 169 boys 6-11 years of age in the school years 1913-14, 1914-15, 1915-16. The average weight and height showed a slight decrease as the war went on. The weight and height of children entering the elementary school in 1915 and in 1916 also showed a slight unfavorable influence of war conditions. The writer concludes that this influence is insignificant compared with the effect of neglected children's diseases.

571. Ott,— Das Pignet'sche Verfahren bei der Aushebung. *Dtsch. militärärzl. Zsch.*, 1911.

Tried out Pignet's formula on recruits and considers it valuable for a rapid survey of recruits.

572. Överland,— Pirquet-undersökelser paa Barn. *Med. Revue*, 1913, 1.

573. Pagliani, L. Sopra alcuni fattori dello sviluppo umano-richerche anthropometriche. *Atti del. r. Accad. di sci. di Torino*, 1875-76, (11), 694-760. Also *Arch. di Anthrop. ed etnol. italiana*, 1876, (6), 129-183.

These children were examined and measured in Turin and the accompanying tables give the effect of growth under favorable and under less favorable conditions, together with the effect of exercise on the development of the lung capacity of boys.

574. Pagliani, L. Lo sviluppo umano per eta, sesso, condizione sociale e etnica studiato nel peso, statura, circonferenza toracica, capacita vitale e forza muscolare. *Giornale del. Soc. ital. d'igiene*, 1879, (1), No. 4, 357-376; No. 5, 453; No. 6, 589-608.

575. Pearson, K. Growth of St. Louis Children. *Nature*, 1894, (51), 145-146.

In this investigation Pearson summarizes Galton's percentile methods and says that it is now acting as a distinct hindrance to statistical theory in an unexpected way, since it does not require the investigator to publish his raw material. A criticism is given of Porter's work on this basis, since the material is only given in the form of percentiles or in diagrams of the "ogive" curve corresponding to the integral of the frequency curve.

*576. Pearson, K. On the Correlation between Weight and Length of Infants at Birth. *Proc. Roy. Soc.*, 1900, (66), 24.

The examination of 1000 male and 1000 female babies (twins excluded) born at the normal period at the Farrbelt Lying-In Hospital showed that the male at birth was larger and more variable than the female at birth. Both sexes lose variability and correlation when they become adult.

See also Pearson, K. On the Handicapping of the First Born. Eugenics Lecture Series X. Cambridge, England: Cambridge University Press.

Gives the weight and length of newly born babies according to their place in family.

577. Pearson, K. On the Correlation of Intellectual Ability with the Size and Shape of the Head. *Proc. Roy. Soc.*, 1901-02, (69-70), 333-342.

Length of head, breadth of head and cephalic index show very small correlations with intellectual ability as shown by college honors in the case of Cambridge men.

578. Pearson, K. On the Laws of Inheritance in Man. II. On the Inheritance of the Mental and Moral Characters in Man, and Its Comparison with the Inheritance of the Physical Characters. *J. Anthropol. Inst.*, 1903, (33), 179-237. Also *Biometrika*, 1904, (3), 131-190.

Gives for stature, span and length of forearm the size and variability of each character in two generations and the parental, fraternal and assortative mating coefficients of correlation.

579. Pearson, K. On the Relationship of Intelligence to Size of Head and to Other Physical and Mental Characters. *Biometrika*, 1906, (5), 105-146.

Head measurements of 1000 Cambridge graduates with examination standing of each. Also measurements of 5000 school children and an intellectual rating. Such small correlations were found between head measurements and intelligence as to be of no service for the purposes of prediction.

580. Peckham, C. W. The Growth of Children. *Rep. of Wis. Bd. of Health*, 1881, (6), 28-73.

About 10,000 children in the various schools of Milwaukee were measured and examined in 1881 (ages from four to 18 years). Eleven plates and 13 tables giving the rates of growth by nationality are included.

581. Peckham, C. W. Various Observations on Growth. *Rep. of Wis. Bd. of Health*, 1882, (7), 185-188.

This investigation showed that there were certain important differences in the rates of growth of Boston children and Milwaukee children.

582. Peiper, E. Ein Beitrag zur Frage der körperlichen Entwicklung der Schuljugend. *Zsch. d. Zentrale f. Volkswohlfahrt "Concordia"*, No. 1, 1911.

583. Peiper, E. Körperliche Entwicklung der Schuljugend in Pommern. *Arch. f. soz. Hyg.*, 1912, (7), 109-137.

For this study 14,194 city children and 28,334 country children were measured in height, weight and chest circumference. Comparative tables are given from other investigators. Country boys are found to be better developed with respect to all three measurements.

*584. Peller, S. Der Einfluss sozialer Momente auf den körperlichen Entwicklungszustand der Neugeborenen. *Österr. San.-Wes.*, 1913, (25), Beiheft V, 1-47.

This is a study of the effect of prenatal care on the weight of the child. Over 4,000 cases were studied in relation to various factors.

*585. PELLER, S. Längengewichtverhältnis der Neugeborenen und Einfluss der Schwangerernährung auf die Entwicklung des Fötus. *Dtsch. med. Woch.*, 1917, (43), 847.

586. PENN, B. A Schoolmaster's Notes on the Growth of Scholars. *Sch. Hygiene*, London, 1917, (8), 116-122.

The writer measured 117 children in a school in London (ages 7½ to 12½) and compared their development with that of children from the south of England.

*587. PERRET,— AND PLANCHON,— Établissement de la courbe de poids des nourrissons, pendant la seconde année. *L'obstetrique*, 1904, (9), 193-203.

This contains a table showing the average weight for each week of the second year (72 subjects). At first the curve ascends very little, forming a sort of plateau, thought to be due to change of diet at the time of weaning.

*588. PETERSSON,— Über die Gewichtsverhältnisse bei Kindern im ersten Lebensjahre. *Upsala Läkareförenings forhandl.*, 1887, (18).

*588a PFANNKUCH, W. Über die Körperform der Neugeborenen. *Arch. f. Gynäk*, 1872, (4).

Study of 714 infants, including weight, length and circumference of head.

*589. PFAUNDLER, M. Körpervolum- und Körperdichtbestimmung am lebenden Säugling. *Zsch. f. Kinderheilk.*, 1911-12, (3), 413-427.

This consists of remarks on Kastner's article and further analysis of the technique necessary for these determinations.

590. PFAUNDLER, M. Körpermass-Studien an Kindern. *Zsch. f. Kinderheilk.*, 1916-17, (14), 1-148.

A detailed consideration and mathematical criticism of some of the previous work on growth. The article has six parts dealing respectively with: (1) Variations in stature; (2) Differences in physical measurements as dependent on social class; (3) Growth curves and formulae; (4) The body surface; (5) The law of equal heat radiation for equal body surfaces; and (6) Body volume and density.

*591. PFEIFFER, E. Bemerkungen betreffend Wachstum und Körperwägungen der Säuglinge. *Jahrb. f. Kinderheilk.*, 1884, (19), 142-147.

The average weight of infants 1-12 months was calculated for nine cases and found to coincide with Bouchaud's findings. The writer gives instances of individual infants whose weight increase does not coincide with Fleischmann's rule that the child at the end of five months weighs twice its first weight plus 550 grams.

592. PFITZNER, W. Social Anthropologische Studien. I. Der Einflusz des Lebensalters auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1899, (1), 325-377.

Contains several tables of growth.

593. PFITZNER, W. Social Anthropologische Studien. II. Der Einflusz des Geschlechts auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1901, (3), 485-575.

Gives several tables of absolute measurements on 2233 men and 1725 women.

594. PFITZNER, W. Social Anthropologische Studien. III. Der Ein-

flusz der socialen Schichtung auf die anthropologischen Charaktere. *Zsch. f. Morph. u. Anthropol.*, 1902, (4), 31-98.

Contains several tables showing the physical peculiarities of the various social classes.

595. PFITZNER, W. Social Anthropologische Studien. IV. Die Proportionen des erwachsenen Menschen. *Zsch. f. Morph. u. Anthropol.*, 1903, (5), 201-314.

Includes many tables showing the correlation between different measurements.

*596. PHILIPPSON, P. Über die Entwicklung junger Säuglinge bei künstlicher Ernährung. *Monatsch. f. Kinderheilk.*, 1913, (12), 157-176.

*597. PIES, W. Über die Dauer, Grösze und den Verlauf der physiologischen Gewichtsabnahme bei Neugeborenen. *Physiologie des Neugeborenen*, 1910.

Out of 150 infants 96 reached their birth weight by the 22nd day.

598. PIGNET,— Valeur numerique de l'homme. Nouveau mode d' appreciation de la force physique exprimée par un nombre tiré de la comparaison des trois mensurations: taille, périmètre et poids. *Arch. méd. d' Angers*, 1900, (4), 453-461.

599. PIGNET,— Du coéfficient de robusticité. *Bull. méd.*, April 27, 1901, No. 33.

Here Pignet explains the significance of his formula for combining height, chest circumference and weight into an index, whose size correlates inversely with increased degrees of physical development. He makes practical use of eight index classes, which give a range from individuals who are over-developed, to those who are weaklings.

600. v. PIRQUET, C. F. Eine einfache Tafel zur Bestimmung von Wachstum und Ernährungszustand bei Kindern. *Zsch. f. Kinderheilk.*, 1913, (6), 253-262.

A chart with curves constructed by reducing the average height and weight (according to Camerer) for each year to a single point, the curve being drawn through these points to represent the development of the average child from birth to 14 years. Camerer's figures have also been arranged in a table of height and weight and values interpolated to permit of finer grading. The article emphasizes the necessity of determining the nutritional condition of a child by comparing its weight, not with the weight for that year, but with the height.

601. v. PIRQUET, C. F. Sitzhöhe und Körpergewicht. *Zsch. f. Kinderheilk.*, 1916, (14), 211-228.

Measurements were made of 128 new born, 54 premature and a number (not stated) of children up to 20 years of age. These are not consecutive measurements on the same individuals, but they show a constant relationship between the cube root of the weight or the cube of ten times the weight, and the sitting height. This index the writer considers a good measure of the nutritional condition of the individual. In normal adults its value approximates 100; in a growing child 94; in conditions of emaciation 81.

602. PISMENNRY, N. H. (Comparison of the Physical Development of Pupils of the Factory and Public Schools of Serpukhor Co., as Related to the Several Conditions of Life of the Factory Population.) *Vestnik. obsh. hig. sudeb. i. prakt. med.*, St. Petersburg: 1905, 506-524.

Russian.

603. PITTARD, E. Influence du milieu géographique sur le développe-

ment de la taille humaine. *Compt. rend. acad. d. sci. Paris*, 1906, (143), 1186-1188.

604. Pittard, E. Comparaison de quelques caractéres somatologiques chez les Turcs et les Grecs. *Rev. anthropol.*, 1915, (25), 446-454.
The writer finds a close relationship morphologically between the Greeks and the Turks. A few tables are included.

605. Pittard, E. Étude anthropométrique des Juifs de Dobrodja. *Rev. anthropol.*, 1915, (25), 139-149.
A study of 74 male subjects, with a few tables. The conclusion is drawn that this group does not resemble the true Jews in its morphological characteristics.

606. Pittard, E. Anthropométrie comparative des populations balkaniques. *Compt. rend. acad. d. sci. de Paris*, 1915, (160), 642-645; 681-685.
Brief remarks reporting the average height, head size, and various indices of several races in the Balkan peninsula. No tables of growth.

607. Poetter,— Messungen und Wägungen von Leipziger Schulkindern im Kriege verglichen mit der Friedenzeit. *Zsch. f. Schulgesundheitspf.*, 1919, (32), 49-57.
Measurements of weight, height and chest circumference made during March, 1917, and February, 1918, compared with normal measurements made in Leipzig in February, 1914. The measurements of children seven to 14 years were averaged for each year period, 3697 children being measured in all. The average weight at all ages was found to have decreased since the war, by one-half to three and one-half kilograms. Average height showed less decrease while chest circumference actually increased in the two war years. Six tables and one graph.

*608. Pollak, L. Die Entwicklung der Säuglinge während des Krieges. *Wien med. Woch.*, 1918, (68), 1044-1049.

*609. Pooler,— *Sixth An. Rep. Birmingham Infants Health Soc.*, 1913.
This article, cited by Robertson, contains norms derived from the measurement of British infants.

610. Popper, J. Über den Zusammenhang zwischen Genie und Körpergrösse. *Polit. anthropol. Rev.*, 1907, (7), 485-492.

611. Porter, W. T. On the Application to Individual School Children of the Mean Values Derived from Anthropological Measurements by the Generalizing Method. *Amer. Statis. Ass'n.*, 1892-93, (3), n. s., 576-587.
A discussion of the significance of deviations above or below normal height and the requirements of a proposed system of physical measurements.

612. Porter, W. T. Untersuchungen der Schulkinder in Bezug auf die physischen Grundlagen ihrer geistigen Entwicklung. *Verhandl. d. Berl. anthropol. Gesellsch.*, 1893, 337-354.
A translation of the former article.

613. Porter, W. T. The Physical Basis of Precocity and Dullness. *Trans. Acad. of Sci. of St. Louis*, 1893, (6), 161-181.
In this investigation, which is based on the previous one, Porter gives 15 tables and two charts, tracing the development by age of dull, mediocre and precocious boys and girls and maintains that "Precocious children are heavier and dull children are lighter than mean children of the same age."

614. Porter, W. T. The Relation Between the Growth of Children and Their Deviation from the Physical Type of Their Sex and Age. *Trans. Acad. of Sci. of St. Louis*, 1893, (6), 263-280.

In this investigation Porter compares the growth of the school children in Freiburg with those in St. Louis and concludes: "The psychological difference between the individual children in an anthropometric series and the physical type of the series is directly related to the quickness of growth."

615. PORTER, W. T. The Growth of St. Louis Children. *Amer. Stat. Ass'n* (quarterly), 1894, (4), n. s., 28-34. Also *Acad. of Sci. of St. Louis*, 1894, (6), 263-380.

This is one of the most significant investigations so far made, including measurements in height, weight and span of arms, strength, girth, measurements of face and head, based on 34,354 children. A careful discussion of the statistical measurements is included. There are 51 tables given in percentile grades and 46 plates. References are appended.

616. PORTER, W. T. Anthropometrical Measurements in Schools. *Educ. Rev.*, 1896, (11), 126-133.

A practical discussion of the study of physical growth from the educational standpoint.

617. PORTER, W. T. Remarks on the Use of Anthropometrical Instruments in Schools. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 158-164.

In this article Porter bases his discussion on the fact that "the average or other central value of the group of properly related measurements gives an idea of the character of the group." Emphasis is laid on types, and we are told that percentile grades can not be used as yet for prediction of future size.

It is recommended that the annual record of the height and weight of every pupil be kept, and that all pupils, whose weight and weight ratio is above the 75 or below the 25 percentile grade of their age, be placed under special supervision in order that they may not be overtaxed by the work required of normal pupils.

618. PORTER, W. T. Seasonal Variations in the Growth of Boston School Children. *Amer. J. of Physiol.*, 1920, (52), 121-131.

Presents data and curves to show seasonal variations in the weight of several thousand children. The same children were weighed every school month from 1909 to 1919. The increase in weight from January to June each year was found to be less than from September to December. This difference was apparently not due to the weight of clothing. The article includes a discusion of the superiority of the individualizing method.

619. PORTEUS, S. D. Cephalometry of Feebleminded. *Train. Sch. Bull.*, 1919-20, (16), 49-72.

A good review of the literature with results on 50 unselected cases. Six tables and five graphs permit of comparison with the percentile tables of the Berry-Porteus investigation of normal individuals. It is concluded that striking deviations from the normal in brain size tend to be associated with mental abnormality. In some measurements, 50% of the feebleminded group differed markedly from the normal. See also an earlier report, *Train. Sch. Bull.*, Oct. 1918, 11.

620. POULTON, E. P. The Relation between Body Weight and Body Length. *Guy's Hosp. Gaz.*, 1917, (31), 50-52.

621. POWYS, A. O. Data for the Problem of Evolution in Man. *Biometrika*, 1902, (1), 31-49.

A mathematical treatment with graphs of the data on Australian criminals, including a discussion of stature between the ages of 15 and 85 and the alteration of stature with old age.

622. PYLE, W. H. *The Examination of School Children.* New York: Macmillan, 1913. Pp. 67.
This contains directions for taking measurements and tables of norms from Smedley and Kotelmann.

623. PYLE, W. H. A Manual for the Mental and Physical Examination of School Children. *Univ. of Missouri Extens. Bull.*, No. 29. Columbia, Mo.: Univ. of Mo., 1920, (21). Pp. 39.
Contains some new norms on country and city children.

624. PYLE, W. H. AND COLLINGS, P. E. The Mental and Physical Development of Rural Children. *Sch. & Soc.*, Nov. 2, 1918, (8), 534-539.
Over 2000 children in an entire county of the state of Missouri were measured and compared with the norms in Pyle's manuals of 1913 and 1916. Comparisons are made of country and city children, showing slight differences only, in physical development though city children are a little better developed.

625. PYLE, W. H. A Study of the Mental and Physical Characteristics of the Chinese. *Sch. & Soc.*, 1918, (8), 264-269.
Comparison of height (standing and sitting), weight, lung capacity, grip, muscular speed, length and breadth of head, are reported, showing the physical measurements of the Chinese in terms of their percentages of the corresponding measures of American children. In general, Chinese children are found "to be physically inferior to American children of the same age." No estimate is made as to how much this is due to racial type.

626. QUETELET,— Sur la taille de l'homme dans les villes et dans les campagnes. *Ann. d'hyg. et de méd. lég.*, 1830.

627. QUETELET, M. A. Recherches sur le poids de l'homme aux différents âges. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique*, 1832-34, (1), 20-24.

628. QUETELET, M. A. *Sur l'homme et le développment de ses facultes, ou essai de physique sociale.* Paris: Bachelier, 1836.
Pioneer work in the field of anthropometry, which studies records from the standpoint of an artist as well as a scientist.

629. QUETELET, M. A. Sur les Indiens Ojib-be-was et les proportions de leur corps. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique*, 1846, (13), 70-76.
A brief scientific study of three Indians.

630. QUETELET, M. A. Sur les proportions des hommes qui se font remarquer par un excès ou un défaut de taille. *Acad. roy. d. sci. d. lettr. et d. beaux-arts de Belgique*, 1847, (14), 138-142.
A short summary with references to Ojib-be-was Indians.

631. QUETELET, M. A. Des proportions du corps humain. *Acad. roy. des sci. d. lettr. et d. beaux-arts de Belgique*, 1848, (15), 16-27.
A discussion of the Egyptians, Romans, and Indians.

632. QUETELET, M. A. Sur les proportions de la race noire. *Intern. Cong. f. Sch. Hyg.*, 1854, (21), 96.

633. QUETELET, M. A. *Anthropométrie au mesure des différentes facultés de l'homme.* Bruxelles: 1870.

634. QUETELET, M. A. *Sur l'homme et Anthropométrie.* Brüssel: 1870.

635. QUIRSFELD, E. Vorträge: Zur physischen und geistigen Entwicklung des Kindes während der ersten Schuljahren. *Intern. Cong. f. Sch. Hyg.*, 1904, (3), 128-134.
A careful study of the physical conditions of children during the first years of school, followed by a discussion by F. A. Schmidt, E. Bayr, and Frau Dr. Krukenberg.

636. QUIRSFELD, E. Zur physischen und geistigen Entwicklung des

Kindes während der ersten Schuljahren. *Zsch. f. Schulgesundheitspf.*, 1905, (18), 127-185.

This is a preliminary report which is to include yearly measurements of the same group of boys and girls from the 6th through the 14th year. So far measurements have been obtained for years 6-10, of height, chest circumference, vital capacity, weight, muscular strength, together with observations on nutrition, scolioses, vision, ear disease, etc.

637. Quirsfeld, E. Untersuchungsergebnisse physischer und geistiger Entwicklung bei 1014 Kindern vom 1 bis 8 Schuljahre. *Prag. med. Woch.*, 1907, (32), 653-656. Translation in *2nd Intern. Cong. Sch. Hyg.*, London: 1907, 214-216.

A study of physical and mental development in early childhood.

638. Radlauer, C. Anthropometrische Studien an Somali (Haschia). *Arch. f. Anthropol.*, 1914-15, n. F., (13), 451-473.

Head measurements and body measurements, 47 in all, are given for 35 subjects, aged five to 35 years.

639. Radosavljevich, P. R. Pedagogical Measurements of Pupils in Mostar, Herzegovina (Austria). *Proc. 4th Intern. Cong. for Sch. Hyg.*, Buffalo: 1913, (5), 541-550.

A large number of pupils of elementary and secondary schools were measured in standing and sitting height, weight and six head measurements. Six tables are given. The usual growth phenomena are traced, but little correlation is noted between physical dvelopment and school brightness.

640. Rambusch,— Skolebörnenes Fysikalske forh. i nogle Midtjydske Sogne. *Medd. Danmarks Anthropologi*, 1907-11, (1), 173.

*641. Ramsey, W. R. and Alley, A. G. Observations on the Nutrition and Growth of New Born Infants; 300 Clinical Charts. *Amer. J. Dis. Child.*, 1918, (15), 408-412.

This is an analysis of 300 clinical charts which gives information in regard to the average birth weight, caloric intake, initial loss of weight, etc. No tables of growth.

642. Ranke, A. E. Anthropologische Betrachtungen aus Zentralbrasilien. *Abhandl. d. k. bayr. Akad. d. Wissensch.* München: 1906, II Kl., (24), 1. Abteilg.

643. Ranke, J. Zur Statistik und Physiologie der Körpergrösse der bayerischen Militärpflichtigen in den 7 rechts-rheinischen Regierungsbezierken nach den Vorstellungslisten der Kgl. Ober-Ersatzkommissionen vom Jahre 1875. *Beitr. zur Anthropol. u. Urgeschichte Bayerns*, 1881, (4).

644. Ranke, J. *Der Mensch.* Leipzig: Verl. d. bibl. Instit., 1894-1900. 2v.

Chapters II and III of Vol. 2 contain excellent material on growth and many tables from Europe and America.

645. Ranke, J. Beiträge zur Frage des kindlichen Wachstums. *Arch. f. Anthropol.*, 1905, (3), 161-180. See also *Der Mensch.*, (2), 156-157.

A very careful study of about 2500 children, with many measurements and tables.

646. Ranke, J. Anthropometrische Untersuchungen an gesunden und kranken Kindern mit besonderer Berücksichtigung des schulpflichtigen Alters. *Zsch. f. Schulgesundheitspf.*, 1905, (18), 719-745; 816-837.

Measurements of the heads of 1468 boys and 1041 girls from birth to 15 years. A distribution table is given, though the investigator is principally interested in the pathological sig-

nificance of these measurements, especially with regard to hydrocephalus.

647. RASMUSSEN, K. The Anthropology of the Greenland Esquimaux. *Nature*, 1908-09, (79), 311.

*648. RAUDNITZ, R. W. Über Lebensbücher und das Massenwachstum der Säuglinge. *Prag. med. Woch.*, 1892, (17), 66-71; 82-84.
The second part of this article contains a brief account of the derivation of the growth formulae of Quetelet, Bouchaud, Fleichmann, and Russow, and a few original observations on individuals from the writer's practice.

*649. RECHT,— *Über das Mittelgewicht neugeborener Kinder.* Diss. Bonn: 1897.
Includes measurements on children born 1893-1896.

650. REGNIER,— *Des maladies de la croissance.* Paris: 1860.

651. REINUS,— *Über die Wachstumskurve.* Diss. München: 1915.
A mathematical discussion of the curve of growth.

652. RETAN, G. M. The Measure and Development of Nutrition in Childhood. *Arch. of Pediat.* 1920, (37), 32-39.
Emphasizes the fact that the standard of normal development is the relation of height and weight at a given age. Five charts show the distribution of children of different height and weights at ages five to 18 into zones of over-nutrition, excellent nutrition, passable nutrition, and malnutrition.

653. REUTER, F. Beiträge zur Anthropologie Hinterpommerns; Kindermessungen. *Arch. f. Anthropol.*, 1903, (28), 288-388.
A careful experimental study based on 373 children, with many measurements, graphs, and indices.

654. RICHARDS, A. AND LITTLE, B. B. A Proposed Standard Chart to Show the Proportions of American Females. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1896, 30-34.
A detailed chart is given showing relative measurements.

655. RIEBESELL, P. Über die Wachstums- und Ernährungsgesetze des Menschen. *Berl. klin. Woch.*, 1916, Heft 5; 1917, Heft 7.
Weight as a function of time is to be used as an index of physiological age.

656. RIEDEL, E. *Die Körperlänge von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1913.

657. RIETZ, E. Das Wachstum der Berliner Schulkinder während dem Schuljahre. *Arch. f. Anthropol.*, 1903, (1), 30-42.
This investigation is based on a study of 5134 Berlin boys and girls between the ages of six and 19, and includes the comparison between children from different types of schools. Twelve tables are included and one chart, with corresponding curves for the Gymnasien and Höhere Schulen and the Gemeindeschulen. A comparison is also made between the children of the better classes and the poorer classes at Hamburg, Berlin, Halle, Gohlis, Saalfeld, Stockholm, Denmark, England, Boston, Turin, Warsaw, and Freiberg, as outlined by Burke but less complete, the number of individuals not being included.

658. RIETZ, E. Körperentwicklung und geistige Begabung. *Zsch. f. Schulgesundheitspf.*, 1906, (19), 65-98.
Measurements of weight and height of 20,400 boys, nine to 20 years old, from Höhere Schulen of Berlin, show that brighter children (judged by school progress) are better developed physically. Many tables and curves are given, closely approximating the normal surface. The brighter boys are also heavier for their height than are the more retarded ones.

659. Ripley, W. Z. The Form of the Head as Influenced by Growth. *Science*. 1896, N. S., (3), 888-889.

Measurements of length and breadth of head on 485 Massachusetts Institute of Technology students at the beginning and end of their four years course, show that growth is almost entirely in length, the cephalic index decreasing with age. A few references are given.

660. Roberts, C. Memorandum on Medical Inspection and Physical Education in Secondary Schools. *Rep. Roy. Comm. on Second. Sch. of Eng.*, (5), 352-374.

This report deals primarily with the relation of weight and height to hygienic conditions and the death rate at various ages.

661. Roberts, C. The Physical Development and Proportions of the Human Body. *St. George's Hosp. Rep.* London: 1874-76, (8), 1-48.

This contains tables showing the average height and the annual rate of growth of English males. Similar tables are given for chest girth, weight, weight-height coefficient, and for various proportions of the body.

662. Roberts, C. The Physical Requirements of Factory Children. *J. of Statis. Soc.*, 1876, (39), 681-733.

An excellent study, including height, weight, and chest girths. Comparisons are made with Quetelet's data.

663. Roberts, C. *Manual of Anthropometry.* London: Churchill, 1878. Pp. 118.

This is an important manual containing much anthropometric material and many references. The height, weight, and annual increments of 7709 boys and men of favored class between 10 and 30 are included. There are also many other tables, one including height, weight and chest girth of new-born infants; another of the average height, weight and chest girth of the artisan class between the ages of four and 50. A careful comparison is made with Bowditch's work in Boston.

664. Robertson, T. B. On the Normal Rate of Growth of an Individual and its Biochemical Significance. *Arch. f. Entwicklungsmech.*, 1897, (25), 581-614.

From the results of the British Anthropometric Committee and of Quetelet the author derives a growth formula which he shows to hold true for plants as well. He believes growth to be an autocatalyzed process.

*665. Robertson, T. B. The Post-natal Loss of Weight in Infants and the Compensatory Overgrowth Which Succeeds It. *Proc. Soc. Exper. Biol. & Med.*, 1914, (12), 66. Same title, *Amer. J. Physiol.*, 1915, (37), 74-85.

*666. Robertson, T. B. The Post-natal Loss of Weight in Infants and the Compensatory Overgrowth Which Succeeds It. *Amer. J. Physiol.*, 1915, (37), 74-85.

This is a study of the average weights of over a hundred Australian infants. The treatment is mathematical and theoretical, the loss phenomena being attributed to mechanical shock during delivery.

*667. Robertson, T. B. A Comparison of the Weights at Birth of British Infants Born in the British Isles, the U. S. and Australia. *Univ. of Cal. Publ. Physiol.*, Berkeley: Univ. of Cal., 1915, (4), No. 20. Pp. 4.

*668. Robertson, T. B. Pre- and Post-natal Growth of Infants. *Amer. J. Physiol.*, 1915, (37), 1-42.

This is a mathematical treatment of growth cycles with tables

and graphs showing the observed and the calculated weights of 251 infants from birth to one year (not the same infants followed throughout). It appears that Australian infants are considerably heavier at first than are British infants.

*669. ROBERTSON, T. B. The Growth of British Infants During the First Year Succeeding Birth. *Amer. J. Physiol.*, 1916, (41), 535.

Carefully collected records of the average weight of 2129 English infants 1-12 months of age are given in five tables and two graphs. These show that Newman's standard (derived from French infants) is too low. The variability of male infants is greater than that of females and the variability is greatest when the velocity of growth is greatest. Calculated growth curves by Robertson's formula are found to agree closely with observed curves.

669a Also The Variability of the Weight and Stature of School Children and Its Relationship to Their Physical Welfare. *Amer. J. Physiol.*, 1916, (41), 547-554.

The records of 50 boys and 50 girls, 6-14 years inclusive, from the schools of Oakland, Calif., were selected at random. The results given in four tables and two graphs show that the rate of growth in weight increases continuously and that the variability in weight undergoes a parallel increase. Stature, on the other hand, increases at an almost uniform rate and the variability of stature is correspondingly uniform. An unfavorable environment operates to decrease both stature and weight, but to increase the variability of stature while decreasing the variability of weight.

*670. ROEDERER,— De pondere et longitudine infantum recens naturum. *Commentaries of the Roy. Soc. of Göttingen*, 1753.

This is a report of measurements of height and weight of 27 new born children.

671. ROHRER, F. Eine neue Formel zur Bestimmung der Körperfülle. *Korr.-Bl. Ges. f. Anthropol.*, 1908, (39), 5.

672. RÖSE, C. Beiträge zur europaischen Rassenkunde. *Arch. f. Rass.- u. Gesellschaftsbiol.*, 1905, (2), 689-798.

Subjects for this study were mostly German school children. Head and face measurements are reported in 73 tables.

673. ROSHDESTWENSKY, A. (Die Kopfgrösze des Menschen in ihrer Beziehung zu Höhe, Geschlecht, Alter u. Rasse.) *Arbeit. d. anthropol. Abt., Moskau*: 1897, (18).

Russian.

674. ROSTOVTSEV, G. J. (Anthropological Study of Children in Schools of District of Dmitrovsk.) *Med. besieda*, 1900, (14), 184-191.

Russian.

675. ROTCH, T. M. Roentgen-Ray Methods Applied to the Grading of Early Life. *Amer. Phys. Educ. Rev.*, 1910, (15), 396-420.

An address with seven photographs and three tables, showing briefly the writer's discoveries on the development of the wrist bones and putting forth the thesis that school grading should be on the basis of anatomic development. Particular stress is laid on the danger of overstraining the nervous system of the bright child with the work of the higher grades before the development of the osseous system shows the child to be sufficiently mature for such work.

676. ROTCH, T. M. A Comparison in Boys and Girls of Height, Weight and Epiphyseal Development. *Trans. Amer. Pediat. Soc.*, 1910, (22), 36-38.

No tables are given, but a graph shows the height and weight

(according to Camerer) and epiphyseal development of boys and girls (500 cases). Whereas the girls' height and weight curves start lower than those of the boys, cross at 12 to 13 years, and are again crossed by the boys' curves at 17 to 18 years, the girls' curve of epiphyseal development is throughout life on a higher level than that of the boys.

*677. ROTT,— Beitrag zur Wesenerklärung der physiologischen Gewichtsabnahme des Neugeborenen. *Zsch. f. Kinderheilk.*, 1910, (1), Heft 1.

678. ROUDENKO, M. S. Resultats de mensurations anthropologiques sur les peuplades du nord-ouest de la Sibérie. *Bull. et mem. soc. d'anthropol. de Paris,* 1914, 6 S., (5), 123-143.
This contains 14 tables and a bibliography of 32 titles.

*679. RÜBNER, M. Wachstum und Ernährung. *Festschr. z. Eröffn. d. k. Auguste Victoriahauses z. Bekämpf d. Säuglingssterbl.* Berlin: 1909, 49-56.

*680. RUSSOW, A. Vergleichende Beobachtungen über den Einfluss der Ernährung mit der Brust und der künstlichen Ernährung auf das Gewicht und den Wuchs (Länge) der Kinder. *Jahrb. f. Kinderheilk.*, 1881, (16), 86-132.
This contains a good résumé of the early literature. Determinations of the weight and height of infants with artificial and breast feeding were made with 184 cases for the average of each month to the end of the first year. Detailed comparisons are given with the figures of Bouchaud and Fleischmann. The writer also measured 900 children 1-8 years and found that the maximal weight and height occurred only with children who had been exclusively breast fed during the first year.

681. SACK, N. *(Die physische Entwicklung der Kinder in den Moskauer Mittelschulen.)* Moskau: 1892.

682. SACK, N. *Brustdurchmesser und das Körpergewicht der Knaben in den Höheren Schulen Moskau's.* Aus dem Russischen übersetzt von Prof. Dr. Erismann, 1892.

683. SACK, N. Über die körperliche Entwicklung der Knaben in den Mittelschulen Moskau's. *Zsch. f. Schulgesundheitspf.*, 1893, (6), 649-663.
A very important study containing many references to the work of others, and comparative tables.

684. SACK, N. (Data on the Characteristics of the Physical Development of Children, Diameter of the Chest, and Weight of the Body). *Vestnik. obsh. hig. sudeb. i. prakt. med.*, 1893, No. 1, 2 sect., 1-34.
Russian.

*685. SAKURAGI, J. *Gewichtsverhältnisse von Säuglingen proletetärischer Bevölkerung bei natürlicher und künstlicher Ernährung.* München: Kastner und Callwey, 1908. Pp. 99.

686. SALOMON,— *Über Messung und Wägung von Schulkindern.* Jena: 1898.

687. SAMOSCH,— Einige bemerkenswerte Ergebnisse von Schulkindermessungen und Wägungen. *Zsch. f. Schulgesundheitspf.*, 1904, Heft 6, (17), 389-403.
Data from 937 boys and 1032 girls, 6-16 years of age, are arranged in eight tables to show the distribution of measures in different school classes and different ages.

688. SANTORI, S. Studio su alcuni indici dello sviluppo fisico e sui rapporti esestenti fra essi, l'agiatezza, l'intelligenza e la condotta; richerchi eseguiti sugli alumni delle scuole elementari del

comune di Roma negli cumi scolastici, 1903-6. *Intern. Arch. f. Schulhyg.*, 1907, (3), 225-242.

689. SARGENT, D. A. Report on the Anthropometric Measurements; A Schedule of Measurements with Directions for Making Them. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1886, (2), 6-15.
A guide for the making and recording of measurements.

690. SARGENT, D. A. The Physical Proportions of the Typical Man. *Scribner's Mag.*, 1887, (2), 3-17.
A semipopular article giving methods of measuring and testing in the physical education of men, with three charts which show at a glance the relation of size, strength, symmetry, and development. These charts have had great influence in laboratories for physical measurements.

691. SARGENT, D. A. The Physical Development of Women. *Scribner's Mag.*, Feb. 1889, 172-185.
A popular article with one table and two graphs showing sex differences in physical measurements.

692. SARGENT, D. A. *Anthropometric Charts for Different Ages, Male and Female, Ranging from 10 to 26 Years of Age.* Cambridge: 1893.
Each chart has a vertical scale for height and weight and a horizontal scale for percentile ratings. Curves are plotted showing the distribution of measurements in the various percentiles above and below the average.

693. SARGENT, D. A. The Physique of Scholars, Athletes, and the Average Student. *Pop. Sci. Mo.*, 1908, (73), 248-256.
A study of 15 groups of men from 18 to 26 years of age, all excepting one group being Harvard students—football players, crew men, strong men, scholarship men, etc. A table of the average height, weight and strength of each group is given, the tallest and heaviest being university crew and football men, the shortest and lightest being "stipend scholarship" men.

694. SAWYER,— STONE,— AND DU BOIS,— Further Measurements of the Surface Area of Adults and Children. *Arch. of Intern. Med.*, (17), 855.

*695. SCANZONI,— (Birth Measurements of Infants). *Lehrb. d. Geburtsh.*, 1849, (1), 95.
Reports the weight of Würzburg infants.

696. SCHADOW, J. G. *Polyclcet oder von den Maassen des Menschen, nach dem Geschlechte und Alter mit Angabe der wirklichen Naturgrösse, &c.* Berlin: 1834.
Interesting from the historical point of view.

*697. SCHAEFFER, O. Über die Schwankungsbreite der Gewichtsverhältnisse von Säuglingen in den ersten 14 Lebenstagen und die Ursachen dieser Schwankungen. *Arch. f. Gynäk.*, 1896, (52), 282-313.
This reports the weight of 592 infants and gives a statistical analysis of various factors that might be the cause of the physiological loss of weight.

*689. v. SCHAETZEL,— *Über den Einfluss des Alters der Mutter und der Zahl der vorausgegangen Schwangerschaft auf Länge und Gewicht des Neugeborenen.* Diss. Greifswald: 1893.

699. SCHERZER, C. AND SCHWARZ, E. Über Körpermessungen als Behelf zur Diagnostik der Menschenrassen. *Mitt. d. Geog. Gesellsch.*, 1859, (3), 11.

*700. SCHICK, B. Ernährungstudien beim Neugeborenen. *Zsch. f. Kinderheilk.* 1917, (17), 1-113.

This is an extensive study of the fluctuation in weight for a few days after birth under the influence of various diets.

701. SCHIFF, F. Anthropologische Untersuchungen an jüdischen Kindern in Jerusalem. *Arch. f. Anthropol.*, 1914, n. f., (13), 348-357.
A study of 604 subjects, but with absolute measurements not recorded.

702. SCHIÖTZ, C. Wachstum und Krankheit. *Zsch. f. Kinderheilk.*, 1915-16, Orig. (13), 393-434.

703. SCHIÖTZ, C. Uproportionert Vekst hos Kvinder. *Norsk. Mag. f.* Laegev., 1916, No. 7.

704. SCHIÖTZ, C. *En Undersokelse av 10,000 Norske Skolebarn Saerlig Med Hensyn Til Vekstforhold.* Reprint from Med. Rev. Bergen: Griegs Boktrykkeri, 1917. Pp. 117.
This is an investigation of the height of Norwegian children from city and country schools, both elementary and higher classes. The writer gives growth curves and increments which he considers normal for Norwegian children. An excellent list of works in the Scandinavian countries is appended.

705. SCHIÖTZ, C. (Measurements and Tables for Determining the Physical Development of Norwegian School Children). *Tidsskr. f. d. norske Taegefor.*, 1918, (38), 490-498.

706. SCHIÖTZ, C. Aldrene 12 til 17 aar. *Med. Rev.*, Apr. 1919.
This article deals with measurements of 231 boys and 177 girls, ages 12 to 17 years, measured under the auspices of the Anthropological Institute of the University of Kristiania. The children came from the families of skilled laborers and trades people. A special study was made of the signs of pubescence. Body volume was calculated for different ages by Rohrer's formula for the "index der Körperfülle." The article includes a discussion of the statistical methods applicable in the field of physical measurements.

707. SCHIÖTZ, C. Kan Skolehygiejnen blive en betydningsfuld Faktor for Befolkningens Helbredstilstand? *Referat af det hygiejniske Möde i Kobenhavn*, Sep. 2-5, 1919, 56-73. Reprint from *Maanedsskrift for Sundhedspleje.*
This is a critical exposition of methods now in use for evaluating physical development. Schiötz refers to the measurements on 33,000 school children now being made under his direction in Kristiania. He stresses the importance of the weight-height index as a criterion of development.

708. SCHIÖTZ, C. Om veining of malling av skolebarn. *Med. Rev.*, Nov.-Dec. 1919, 551-561.
This is a reply to Hansen's criticism of the use of Rohrer's formula. Schiötz thinks that the Rohrer "index der Körperfülle" is far better than Pignet's index which Hansen approves.

709. SCHIÖTZ, C. Utviklingsforhold hos barn i 2 til 6 aars alder. *Norsk. Mag. f. Laegevidensk.*, 1920, (81), 425-459.
In this article are reported the results of an investigation of 264 boys and 249 girls in orphanages in Kristiania. The writer finds characteristic differences in the development of the sexes at different ages, and differences in the "index der Körperfülle." Comparisons are made with measurements supplied by Törnell (Sweden) and Hertz.

710. VON SCHJERNING,— Sanitätsstatistische Betrachtungen über Volk und Heer. *Bibliothek v. Coler u. Schjerning*, 1910, (28).

711. SCHLAGINHAUFEN, O. *Anthropometrische Untersuchungen an Eingeborener in Deutsch-Neuguinea.* Leipzig: 1914. Pp. 82.

712. SCHLESINGER, E. Der Einfluss der durch die Kriegslage veränderten Ernährung auf die schulpflichtige und die heranwachsende Jugend. *Arch. f. Kinderheilk.*, 1916, (66), 161-179.

Measurements made in 1916 on 1320 boys 6-18 years of age from elementary schools and continuation schools attended by both the lower and the better social classes are compared with measurements on the same classes of children made in 1913 and 1914. Additional measurements on 1050 boys of all social classes for the year 1916 are compared with similar measurements for the years 1906 and 1909. The physical growth of these children was very little influenced by war conditions, though weight and general constitution were slightly affected. Height suffered no stagnation whatever.

713. SCHLESINGER, E. Unterschiede im Wachstum bei Schulkindern und jungen Leuten von verschiedener Konstitution und aus verschiedenen Bevölkerungsschichten. *Dtsch. med. Woch.*, 1917, (43), 1607. Same title, *Strassb. med. Zeitg.*, 1917, (14), 165-168.

714. SCHLESINGER, E. Das Wachstum der Knaben und Jünglinge vom 6 bis 20 Lebensjahr. *Zsch. f. Kinderheilk.*, 1917, (16), 265-304.

Measurements are given for about 10,000 boys from Gymnasien, Realschulen, Oberrealschulen, schools preparatory to these, and from Fortbildungsschulen. The results are treated separately for the well-to-do and the poorer industrial classes. In general the children of well-to-do families were superior in height, weight and chest circumference. Complete distribution tables are given.

*715. SCHLOSS, E. Zur Pathologie des Wachstums im Säuglingsalter. *Jahrb. f. Kinderheilk.*, 1910, (72), 575-598.

A discussion of the concept of growth according to various investigators and the effect of nutrition, with four curves. No tables.

*716. SCHLOSS, E. *Die Pathologie des Wachstums im Säuglingsalter.* Berlin: Karger, 1911. Pp. 163.

An excellent treatment of growth from the physiological and nutritional points of view. Many graphs, illustrating the pathology of growth.

*717. SCHLOSS, E. *Über Säuglingsernährung.* Berlin: Karger, 1912. Pp. 231.

This contains much experimental material with weight curves on infants, in health and disease, showing the effect of various diets, summer heat, etc.

*718. SCHMID-MONNARD, K. Über den Einfluss des Militärdienstes der Väter auf die körperliche Entwicklung ihrer Nachkommenschaft. *Jahrb. f. Kinderheilk.*, 1892, (33), 327-350.

About 2700 children, mostly from Frankfurt on Main, ages birth to 30 months, were measured. Schmid-Monnard believes his curves can be taken as norms for German children from the families of workingmen. No great difference was found between the children of those who had been judged fit for military service and those who had not served.

719. SCHMID-MONNARD, K. Über den Einfluss der Jahreszeit und der Schule auf das Wachstum der Kinder. *Jahrb. f. Kinderheilk.*, 1895, (40), 84-107.

Malling-Hansen's "periods of growth" are found to hold true of German children as a result of the measurement of 190 children (2-13 years of age) in Halle, throughout a year at intervals of three to six weeks.

720. SCHMID-MONNARD, K. Gewichts- und Längenzunahme bei Kindern. *Zsch. f. Schulgesundheitspf.*, 1896, (9), 317-323.
A reply to criticisms of "Über den Einfluss der Jahreszeit und der Schule auf das Wachstum der Kinder."

721. SCHMID-MONNARD, K. Die chronische Kränklichkeit in unseren Mittleren und Höheren Schulen. XII Int. Med. Cong. zu Moskau, 1897. *Zsch. f. Schulgesundheitspf.*, 1897, (11), 593-620; (12), 666-685.
In an investigation made in Halle on 5100 boys and 3200 girls in the high and middle schools, the writer studied the chronic diseases, fatigue, etc., in respect to effects, and growth in height and weight in individual children through the 14th year.

722. SCHMID-MONNARD, K. Über den Werth von Körpermaassen zur Beurtheilung des Körperzustands von Kindern. *Korrespondenzbl. f. Anthropol.*, 1900, (31), 130-133.
This article reports measurements for 1021 boys and 1071 girls from birth to 14 years. A comparison of the weight of individual children with the average for children of that particular height shows that weight may vary 10 to 20 per cent from that given in the table and development still be normal.

723. SCHMID-MONNARD, K. Über den Werth von Körpermassen zur Beurteilung des Körperzustandes bei Kindern. *Jahrb. f. Kinderheilk.*, 1901, (53), 50-58.
This article emphasizes the necessity for norms for each nationality, locality, etc. Measurements are reported for Halle children as follows: 2000 pre-school children; 500 Volksschüler, 6-7 years; 1700 Mittelschüler, 6-15 years; 1000 Ferienkolonisten, 8-14 years—boys and girls in equal numbers. The average height of heels and weight of clothing is reported for correcting the norms. The development curves have much the same shape as those of Axel Key, Kotelmann, Schmidt, Hasse, and Daffner. Children of the better classes were found to be of superior development.

724. SCHMIDT, E. Die Körpergrösse und das Gewicht der Schulkinder des Kreises Saalfeld. *Arch. f. Anthropol.*, 1892, (21), 385-434.
A comparative study of the growth of boys and girls between the ages of six and 13 in different localities in Germany.

725. SCHMIDT, F. A. AND LESSENICH, H. H. Über die Beziehung zwischen körperlicher Entwicklung und Schulerfolg. *Zsch. f. Schulgesundheitpf.*, 1903, (16), 1-7.
The writers measured 4260 girls of the city of Bonn. Data are given in four tables showing the average weight and height of pupils in each of seven school grades at each year from 5-15 (not measurements of the same individual). The results confirm those of Grazianoff, Sack, Porter, and others, who found that better pedagogical attainments went hand in hand with better physical development. See also SCHMIDT, F. A., *Leibesübungen und Geistesbildung.* Göttlingen: Bandenhoeck u. Ruprecht, 1920. Pp. 39.

*726. SCHRENK,— *Studien über Schwangerschaft, Geburt und Wochenbett bei der Esthin.* Diss. Dorpat: 1880, 361.
Reports length of 300 cases.

*727. SCHRODER,— (Birth Measurements of Infants) *Lehrbuch d. Geburtshilfe,* 1886, 9th ed. 60.

728. SCHULTZ, G. Bericht über die Messungen an Individuen von verschiedenen Nationen. *Acad. imper. d. sci. de St. Petersburg.* (Bull. d. I. classe physico-mathematique), 1845, (4), 226-230.
A comparative study of 63 Russians, Jews and negroes.

*729. SCHULZ,— *Über die Gewichtsverhältnisse der Säuglinge am 10 Lebenstage gegenüber dem Gewichte bei der Geburt.* Diss. Greifswald: 1903.

730. SCHUSTER, E. First Results from the Oxford Anthropometric Laboratory. *Biometrika*, 1911-12, (8), 40-51.
This consists of three tables giving head measurements with their means, standard deviations and correlation coefficients.

*731. SCHUTE,— Natürliche Ernährung und Gewichtsverhältnisse von 100 Säuglingen der Osnabrücker Hebammenlehranstalt. *Dtsch. med. Woch.*, 1915, (41), 618-620.
This gives a combined weight curve of 56 boys and 44 girls from birth to 18 days. The same children were not followed consecutively. There is one graph, not very clearly explained, however.

*732. SCHÜTZ,— (Birth measurements of Infants of Leipzig). *Beiträge z. Geburtsh., Gynäk., u. Pädiat.* (Festgabe f. Crede's Jubileum, 1881.

733. SCHUYTEN, M. C. *Stad Antwerpen, Paedologisch Jaarboek,* 1902-1903. Leipzig: F. Brandstetter.

734. SCHUYTEN, M. C. De voedings coefficient van de Antwerpsche Scholieren. *Nederl. Tijdschr. v. Geneesk.*, 1919, (1), 457.

735. SCHWARZ, E. *Anthropology* (Novara Expedition). A System of Anthropometrical Investigations as a Means for the Differential Diagnosis of Human Races. Vienna: 1862. Pp. 24.

736. SCHWERZ, F. Untersuchungen über das Wachstum des Menschen. *Arch. f. Anthropol.*, 1911, n. F. (10), 1-38.

737. SCHWERZ, F. *Über das Wachstum des Menschen.* Bern: Drechsel, 1912. Pp. 28.

738. SCHWIENING, H. Beiträge zur Rekrutierungsstatistik. *Klin. Jahrb.*, 1908, (18).

739. SCHWIENING, H. Über die Körperbeschaffenheit der zum Einjährigen freiwilligen Dienst berechtigten Wehrflichtigen Deutschlands. *Veröffentl. a. d. Geb. d. Militär-Sanitätswesens,* 1909, H. 40.
This introduces Pignet's formula in Germany, and uses it on 52,066 young men. The formula is not found to be of much help in judging the individual but is useful for comparative measures of large groups.

740. SCHWIENING, H. Körpergrösse und Körpergewicht des Menschen. *Dtsch. med. Woch.*, 1914, (40), 498-500; 556-558.
Measurements of 113,000 German recruits 20 to 22 years old with respect to weight and height. The data are analyzed in 6 tables and 1 graph dealing with occupation, geographical distribution, etc. Comparisons are made with the data of Hassing, and the work of Gaertner is discussed.

741. SEAVER, J. W. *Anthropometric Tables Arranged from the Measures of 2300 Students.* New Haven: 1889.
A table giving percentile values for 50 different measurements with ages ranging between 16 and 21 years.

742. SEAVER, J. W. Some New Anthropometrical Data. *Yale Med. J.*, 1895-96, (2), 149.

743. SEAVER, J. W. *Anthropometry and Physical Examination, for Practical Use in Connection with Gymnasium Work and Physical Education.* Meriden, Conn.: Curtis-Way Co., 1909. Pp. 191.
This is an important contribution to the general subject of anthropometry and contains 15 chapters on various anthropometric subjects. Chapters VII, VIII and IX, on graphic

anthropometry, the law of growth and percentile methods of tabulation, are particularly good. A number of important charts and tables are included.

744. Seggel,— Über das Verhältnis von Schädel und Gehirnentwicklung zum Längenwachstum des Körpers. *Arch. f. Anthropol.*, 1903, n. F., (1).

Tables of growth are constructed from over 3000 measurements.

745. Seggel,— Verhältnis von Schädel und Gehirnentwicklung zum Längenwachstum des Körpers. *Arch. f. Anthropol.*, 1904, (29), 1.

Tables constructed from 3068 measurements on 700 Gymnasium pupils of München.

746. Seiler, B. W. *Naturlehre des Menschen mit Bemerkungen aus der vergleichenden Anatomie für Künstler und Kunstfreunde.* Leipzig: Arnoldische Buchhandlung, 1826.

747. Seligman, C. G. The Physical Characters of the Arabs. *J. Roy. Anthropol. Inst. Gr. Brit. and Irel.*, 1917, (47), 214-237.

748. Sergi, G. An Anthropological Cabinet for Pedagogic Purposes. *Educ.*, 1886, (7), 42-49.

In his discussion on the formation of an anthropological cabinet Sergi files a detailed biographical chart, including both physical and mental observations, together with remedial agencies and educational measures.

749. Seyffarth,— Beitrag zur Verwertbarkeit des Pignet'schen Verfahrens. *Dtsch. militärärzl. Zsch.*, 1911.

The writer has tried out Pignet's formula on recruits, and agrees in the main with Ott.

*750. Sfameni,— (Birth Measurements of Infants). *Annali di ostetricia e ginecologia*, 1901, No. 9.

Reports the measurements of 126 boys and 126 girls.

751. Shortt, J. Notes on Differences in Weight and Stature of Europeans and Some Natives of India. *Trans. Ethnol. Soc.*, London: 1863, N. S., (2), 213-216.

This includes six tables of average measurements with 20 to 60 subjects.

752. Shuttleworth, G. E. The Health and Development of Idiots Compared with Mentally Sound Children of the Same Age. *Proc. Assoc. of Med. Off. of Amer. Inst. for Idiotic and Feeble-minded Persons*, 1876-86, 315-322. Also published by J. B. Lippincott, Philadelphia, 1877. (See also Tarbell, G. G.)

A very good paper on the growth and mortality of mentally deficient children, with valuable tables and height and weight curves.

753. Sichoff,— *(Measurement of Volume and Surface of the Body of Children.)* Diss. Petrograd: 1902.

*754 v. Siebold, E. Über die Gewichts und Längenverhältnisse der neugeborenen Kinder, über die Verminderung ihres Gewichts in den ersten Tagen und die Zunahme desselben in den ersten Wochen nach der Geburt. *Monatsch. f. Geburtsk.*, 1860, (15), 337-354.

This is an interesting article historically. It contains the birth weight and length of 3000 children.

755. Siegmund-Schultze, F. Die Wirkung der englischen Hungerblockade auf die deutschen Kinder. Sonderabdruck aus *Die Eiche*, Berlin: Zillesen, 1919. Pp. 32.

This pamphlet contains statements regarding the effect of food shortage on public health in general. Both adults and children are said to have suffered shockingly in weight. A table for

21 children weighed Jan. 1, 1916, Jan. and June, 1917, Jan. and June, 1918, Jan. 1919, reveals far less than the normal increase in weight. As the ages of the children are not given, the table is of little statistical value.

*756. SIESEL, P. *Über wiederholte Geburten derselben Frau in Bezug auf Gewichts- und Längenverhältnisse des Kindes.* Diss. Strassburg: 1905.

*757. TEN SIETHOFF, E. G. A. Over de voeding van det Kind in het eerste levensjaar in het bizzonder over de voeding met onze Kindermelk. *Nederl. Tijdschr. v. Geneesk.*, 1899, 2 R., (35), d. 1, 305-321.

*758. SIEVEKING, C. H. Gewichtstabellen von Brustkindern und künstlich ernährten Säuglingen der Hamburger Fürsorgestellen 1913. *Zsch. f. Säuglingsfürsorge*, 1914-15, (8), 154-159.

759. SILBERMANN, J. T. Proportions physiques ou naturelles du corps humain exprimées en mesures métriques et rapportées à la taille de 1.60 m. *Compt. rend. acad. d. sci. de Paris*, 1856, (42), 454-456; 495-497; (43), 1156-1157.

A study of 511 men from 156 mm. to 184 mm.

760. SIMON, G. Untersuchungen an wehrpflichtigen jungen Badnern nach dem Pignet'schen Verfahren. *Arch. f. soz. Hyg.*, 1912, (7), 138.

Pignet's formula was found useful for a general survey of the physical strength and development of recruits, for comparing recruits from different districts and different vocation groups, and for comparing recruits within a vocation.

761. SIMON, T. Recherches anthropométriques sur 223 garcons anormaux âgés de 8-23 ans. *Année psychol.*, 1899, (6), 191-247.

A very careful study of 223 boys, with measurements and a résumé of the work done by others, including comparative tables.

762. SIMON, T. Recherches céphalométriques sur les enfants arriérés de la colonie de Vaucluse. *Année psychol.*, 1900, (7), 430-489.

Head measurements are reported for 100 feeble-minded children of all degrees of mental defect.

763. SKIBINSKI,— *Das Körpergewicht von Münchner Schulkindern.* Diss. München: Müller & Steinicke, 1914.

764. SMEDLEY, F. W. *Rep. Dep. Child-Study and Pedag. Investig., Chicago Pub. Schools.* Chicago: 1900, (2), 10-48.

This report is the continuation of the work started by W. S. Christopher. It contains tables and charts of norms resulting from the measurement of height, weight, vital capacity, grip, and the use of the ergograph with Chicago public school children, and a discussion of the correlation between these results and school standing.

765. SOGRAF, N. J. Anthropometrical Researches in the Provinces of Jaroslav, Kostroma, and Vladimir. *8th Cong. of Russian Naturalists and Physicians.* St. Petersburg: 1890.

766. SOLHAUG, L. S. A Comparative Anthropometric Study. *U. S. Nav. Med. Bull. Washington*: 1920, (14) 1-8, 4ch.

*767. SPIEGELBERG,— (Birth Measurements of Infants) WIENER: *Lehrb. d. Geburtsh.* 1882-84.

Reports the weight of infants in Breslau.

768. SPIELREIN, I. Über Kindermessungen in Rostow am Don. *Zsch. f. Schulgesundheitspf.*, 1916, (29), 451-461; 503-513; 548-560.

In the spring of 1913, 2000 South Russian boys and girls, aged 6-15 years, were measured to determine the effect of schools on physical development. Height, weight, chest circumference and dynamometer performance were recorded. Spielrein

agrees with other authorities who find that school stimulates physical development. Racial comparisons and classification of children according to occupation of parents, house rent, various physical indices, etc. are included. A positive correlation was found between physique and intelligence, that is, boys with larger chest circumference reached the higher school grades.

769. Spier, L. The Growth of Boys: Dentition and Stature. *Amer. Anthropol.*, 1918, (20), 37-48.

770. Spitzer, O. Untersuchungen an Krakauer Mädchen. *Mitt. d. anthropol. Gesellsch. in Wien*, 1915, (45), 210-215.
A study of the head and body measurements of 1000 Polish girls, ages six to 15 years. Thirteen tables are included.

771. Spitzy, H. *Die körperliche Erziehung des Kindes.* Berlin and Wien: Urban und Schwarzenberg, 1914. Pp. 424.
This is principally concerned with physical training, but contains a chapter on embryological and one on later development.

772. Springer,— *Etude sur la croissance et son rôle en pathologie.* Paris: 1890.

773. Stanway, S. Results of Investigations Made into the Comparative Condition of Factory and Non-Factory Children in Manchester and Stockport. (Report of the Factory Commission) London: *Parliam. Rep.*, 1833, (20), DI, 87.
This is the report of the commission of which Cowell was chairman. It was found from an investigation of 1062 factory and 288 more favored children that the latter were better developed physically.

774. Starkow,— *(The Physical Development of the Pupils of Military Schools).* St. Petersburg: 1897.
Russian, cited by Wiazemsky.

775. Steet, G. C. Development and Growth of Boys between 13 and 20 Years of Age. *St. George's Hosp. Rep.* London: 1874-76.

776. Steinhaus,— Proceedings of the 13th Annual Congress of the German Society for School Hygiene and the 5th Annual Congress of German School-physicians. *Zsch. f. Schulgesundheitsp.*, Beiheft, 1913.
Norms for German children who have completed their sixth year are given for height, weight, chest circumference and skull circumference, with the recommendation that children should not in general be admitted to school before this age or before these minimum physical requirements are met.

777. Stephenson, W. On the Rate of Growth in Children. *Trans. 9th Intern. Med. Cong.* Washington: 1887, (3), 446-452.

778. Stephenson, W. On the Relation of Weight to Height and the Rate of Growth in Man. *Lancet-Clinic*, 1888, (2), 560-564.
In this report Stephenson gives four tables and two charts, and maintains that had we the means of scientifically comparing the relation of weight to height and of drawing conclusions therefrom, such data would be as frequently supplied as is now the daily temperature. The first table checks up the height and weight in inches with yearly increments for boys and girls between the ages of five and 18. The height and weight indices are also given, and a comparison between the height and weight coefficients of laboring and nonlaboring classes.

779. Sternberg, G. Physique of Accepted Recruits and Reenlisted Men of United States Army. *Rep. Surg. Gen. U. S. A., to Sec'y of War.*, Washington: 1893, (20), 226-227.

780. Stewart, S. F. A Study of Physical Growth and School Standing of Boys. *J. of Educ. Psychol.*, 1916, (7), 414-426.

This deals with the weight and height of 207 boys in the elementary and high school of the University of Chicago. The chief conclusion, supported by 13 charts, is that "when we consider averages of groups of the same age the group one year ahead of the normal grade averages both heavier and taller than the group of the normal age."

781. STIEDA, L. Über die Anwendung der Wahrscheinlichkeitsrechnung in der anthropologischen Statistik. *Arch. f. Anthropol.*, 1882-83, (14), 167-182.

An extensive theoretical discussion of measurements, with graphs.

782. STILES, C. W. AND WHEELER, G. A. Heights and Weights of Children. *U. S. Pub. Health Reports*, 1915, (30), Part 2, 2990-3003.

This is a study of white children in a southern U. S. city. Measurements for 771 boys and 881 girls are reported in two groups; first from homes of good sanitary condition; second, from homes of poor sanitary condition. The superiority of the children from homes of good sanitary condition is shown by the fact that in 24 total year groups (12 for boys, 12 for girls, ages six to 17) the children from better homes excelled in height in 16 periods, those from poorer homes only in eight periods. With respect to weight, children from superior homes excelled in 15 periods, those from inferior homes in nine periods.

*783. STOCKTON-HOUGH, J. Statistics Relating to Seven Hundred Births (White) Occurring in the Philadelphia Hospital from 1865-72. *Philad. Med. Times*, 1885-86, (16), 92-94.

A table is given showing the effect of the age of the mother and of the number of previous pregnancies on the length and weight of the offspring. Another table shows the relation between the entire length and the length of the trunk of the new born child. Female children are found to be lighter at birth and to have a greater proportional length of trunk.

*784. STOLL,— *Über Gewichtsveränderungen Neugeborener.* Diss., 1876.

*785. STOLTE, K. Über Störungen des Längenwachstums der Säuglinge. *Jahrb. f. Kinderheilk.*, 1913, (78), 399-425.

An excellent discussion of growth problems and literature including the purely physiological work. Two normal height curves are given with data on diet, etc., also curves for 17 children who were suffering from various nutritional disturbances and whose curves show a considerable effect upon growth.

786. STORY, W. W. *The Proportions of the Human Figure, According to a New Canon for Practical Use, with a Critical Notice of the Canon of Polycletus, and of the Principal Ancient and Modern Systems.* London: 1866. Pp. 63.

A detailed study of parts of the body, with many allusions to the work of classical artists.

787. STRATZ, C. H. Über die Körperformen der eingeborenen Frauen auf Java. *Arch. f. Anthropol.*, 1898, (25), 233-242.

788. STRATZ, C. H. Das normale Wachstum. *Vierteljahrssch. f. körperl. Erziehung*, 1908, (4), 135.

789. STRATZ, C. H. Wachstum und Proportionen des Menschen vor und nach der Geburt. *Arch. f. Anthropol.*, 1909, (8), 287-297.

A good article discussing growth before and after birth and giving many drawings and graphs.

790. STRATZ, C. H. Über die Normalgestalt des Menschen. *Arch. f. Anthropol.*, 1911, n. F., (11), 43-49.

791. STRATZ, C. H. Grösse und Proportionen der menschlichen Rassen. *Arch. f. Anthropol.*, 1911, n. F., (10), 226-232.

792. STRATZ, C. H. Het normale Gewicht van Kindern. *Nederl. Maandschr. v. verlosk. en vroumenz en v. Kindergeveesk.*, 1912, (1), 376-380.

793. STRATZ, C. H. Gestalt und Wachstum des Kindes. In KRUSE & SELTER: *Die Gesundheitspflege des Kindes.* Stuttgart: Enke, 1914, 7-28.

A general account of growth with references and comparative tables of results from different investigators and graphic representations of changes in body proportions.

794. STRATZ, C. H. Betrachtungen über das Wachstum des Menschen. *Arch. f. Anthropol.*, 1915, n. F., (14), 81-88.

This contains one table and much bibliographical material.

795. STRONG, E. K. *Effects of Hookworm Disease on the Mental and Physical Development of Children.* (Inter. Health Comm. Public. No. 3.) New York: Rockefeller Foundation, 1916.

Data are given for 115 children, some normal and some in various stages of recovery from the disease. Height and weight are somewhat affected but not so much as one would expect from the nature of the disease.

796. SULIGOWSKI, F. Kilka slów o pomiarach antropomentrycznych mlodziezy gimnazyum mezkiego w Radomin. *Medyeyna*, Warszawa: 1887, (15), 512, 544, 558-559, 641.

The anthropometric measurements of pupils in the gymnasium of Radom. This investigation deals primarily with statistics in height and weight, together with other measurements and personal characteristics of 1783 males between the ages of nine and 21.

797. SÜNDELL,— Mätningar a Stockholms folkskolebarn. *Hygienisk Tidsskrift*, 1917.

798. SZEPESSI, S. (Some Body Dimensions of the Magyar Race) *Honvédorvos*, 1897, (10), 9.

Russian.

799. TALBOT, P. A. Notes on the Anthropometry of Some Central Sudan Tribes. *J. Roy. Anthropol. Inst. Gr. Brit. & Irel.*, 1916, (46), 173-183.

This includes tables giving the individual measurements of 123 subjects and also tables of average measurements.

800. TALLANT, A. W. A Medical Study of Delinquent Girls. *Bull. Amer. Acad. of Med.*, 1912, (13), 283-293.

A study of the physical development of the delinquent girls at Sleighton Farms, Pennsylvania. These girls are about normal in height and weight when compared with Bowditch's norms, but have many sense defects, while 20-25 per cent have venereal diseases.

801. TARBELL, G. G. On the Height, Weight and Relative Rate of Growth of Normal and Feeble-minded Children. *Proc. Ass'n. Med. Off. of the Amer. Inst. for Idiotic and Feeble-minded Persons*, 1876-86, 188-189.

A short paper with height and weight curves.

802. TARBELL, G. G. *Proc. Ass'n. Med. Off. of the Amer. Inst. for Idiotic and Feeble-minded Persons*, 1888-89.

A pioneer study on the growth of feebleminded, the value of which is chiefly in its suggestive material, since few children are included and no statistics are given, although curves of growth are included.

803. TAYLOR, J. J. Anthropometric Notes on the Inhabitants of Checkheaton, Yorkshire. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 507-510.

A comparative study of 20 men, varying from 20 to 60 years of age and from 156.3 to 183.6 cm. in height, and 11 women from 20 to 25 years of age ranging from 146.4 to 163.7 cm. in height.

804. TAYLOR, J. M. The Influence of Bodily Exercise upon Length of Life. *Amer. Ass'n. for the Adv. of Phys. Educ.*, 1897, (7), 61-74.
Contains a number of individual measurements, together with a detailed sketch of the athletic life of William B. Curtis, and concludes that the harmful effects of violent athletic competitions are popularly overrated.

*805. TAYLOR, R. The Proportionate Measurements of 250 Full Term New-born Infants. *Amer. J. of Physiol.*, 1918, (45), 569.

*806. TAYLOR, R. Measurements of 250 Full Term New Born Infants. *Amer. J. Dis. Child.*, 1919, (17), 353-362.
This reports the measurements (16 items), together with correlations and compares the results with those of previous investigators.

807. TERMAN, L. M. *The Hygiene of the School Child.* New York: Houghton Mifflin Co., 1914. Pp. 417.
Contains chapters on the general laws of growth.

808. TEUMIN, S. Topographisch-anthropologische Untersuchungen über die Proportionsverhältnisse des weiblichen Körpers. *Arch. f. Anthropol.*, 1902, (27), 379-432.
A study of 100 subjects, with tables of absolute and relative measurements.

809. TEZYAKOFF, N. (Physical Development of the Public School Pupils of Yelisavetgrad County). *Vestnik obsh. hig. sudeb. i. prakt. med.*, 1896, (29), 2 sect., 121-138.
Russian.

810. THIELE,— (Influence of Disease, especially Tuberculosis, on the Growth and Nutrition of School Children.) *Berl. klin. Woch.*, 1915, (52), 949-950.
Averages obtained by taking the height and weight of 1000 healthy children of Chemnitz for the first and eighth school year, compared with averages for anaemic and tuberculous children, showed that anaemia did not have much effect upon development, but tuberculosis hindered normal growth.

811. THIELE,— Der Einfluss der kreigsmässig veränderten Ernährung auf unsere heranwachsende Jugend. *Berl. klin. Woch.*, 1916, (53), 780-781.
This is a comparison of the measurements of 14 year old children of Chemnitz before the beginning of the war with measurements of a similar age group in 1916. No harmful effect on physical development was apparent although too few cases were measured to furnish reliable comparisons.

812. THOMA, R. *Untersuchungen über die Grösse und das Gewicht der anatomischen Bestandtheile des menschlichen Körpers.* 1882.

813. THOMA, R. *Weiteres über die Grösse und das Gewicht.* Leipzig: 1882.

814. THOMA, R. Untersuchungen über das Schädelwachstum und seine Storungen. *Virchow's Archiv. f. path. Anat.*, 1918, (205), 97-114.

815. THOMAS, C. J. (Physical Development of Young Children in Southwark) *Rep. of Med. Off. L. C. C.* (Ed.), 1905, 7-11.
Cited by Kerr.

816. THOMSON, A. S. Observations on the Stature, Bodily Weight, Magnitude of Chest, and Physical Strength of the New Zealand Race of Men. *J. of the Geog. Soc.*, 1853, (23), 87.

817. Thorndike, E. L. Physical Growth of Children. In *Notes on Child Study* (Columbia Univ. Contrib. to Philos., Psychol. and Educ.) New York: 1901, 21-30.

A very suggestive and valuable chapter, which serves to answer the question "At what rate do children grow and what are the sizes they reach year after year?" Boas' averages and mean variations are included and distribution figures for different ages, also a series of yearly increments of growth in stature for boys and girls.

818. Thorndike, E. L. *An Introduction to the Theory of Mental and Social Measurements.* New York: Science Press, 1904. Pp. 212.

An excellent book on how to handle mental, social and physical measurements. Chapter XII treats of the sources of error in measurements and Chapter XIII gives conclusions and further references.

819. Thorne, L. S. The Physical Development of the London Schoolboy; 1890 examinations. *Brit. Med. J.*, 1904, Part 1, 829-831.

These are measurements of scholarship boys. (For girls see Berry). The height and weight of boys nine to 16 years are reported in a table.

820. Tichanoff, M. T. *(Energy of Growth at the Extremities and Vertebral Column at 14 Years of Age.)* St. Petersburg: Mendeleviteb, 1894.

821. Titchener, E. B. Anthropometry and Experimental Psychology. *Philos. Rev.*, 1893, (2), 187-192.

A discussion of the relation between the anthropometric laboratory and psychological laboratory. The main difference between the two laboratories is one of aim and practice on the part of those who are being trained. Training in the former depends less on practice and more on instruction than in the latter.

822. Topinard, P. *L'anthropologie.* Paris: 1895. (Bibliotheque des sciences contemporaines.)

A general treatment of anthropology with exceptionally strong chapters on craniometry and short chapters on physical characteristics and growth.

823. Törnell,— En Svensk Folkskola pa Landet. *Hygiea*, 1909, 911.

*824. Townsend, C. W. The So-Called Physiological Loss in Infants. *Boston Med. & Surg. J.*, 1887, (116), 157-160.

An analysis of the cause of the loss in weight with report on previous work and tables showing the average losses and gains of a number of hospital infants.

825. Tuckermann, F. *Anthropometric Data Based Upon Nearly 3000 Measurements Taken From Students.* Amherst: 1888.

826. Tuxford, A. W. A Measure of Physical Development in School Children. *Sch. Hygiene*, 1917, (8), 656-659.

The author compares the relation between the stages of development reached by a child or group of children and the normal stage for the same age or ages.

827. Tuxford, A. W. and Glegg, A. R. The Average Height and Weight of English School Children. *Brit. Med. J.*, 1911, (1), 1423-1424.

The average height and weight of 583,640 children aged three to 14 years, is reported. These measurements made in 1909 and 1910 by school medical officers are analyzed in two tables and one graph, comparisons being made between city and country children and between children for the North and those from the South of England.

828. TYLER, J. M. Growth in Weight and Height. In *Growth and Education.* Boston: Houghton Mifflin Co., 1907, 263-270.

One chapter from a good book on growth and an appendix which gives a series of compound tables for weight, height and other measurements. References are appended.

829. TYLER, J. M. The Study of Growth in Children. *J. of the Nat. Educ. Ass'n. of the U. S.*, 1908, 913-916. Also *J. of Educ.*, 1908, (68), 113-114.

A good general discussion without measurements.

*830. UFFELMANN,— *Handb. d. Hyg. des Kindes*, 1881.

Deals with the growth of infants.

831. URICK, A. L. *Rep. Bur. of Labor Statis.*, Des Moines, Iowa: 1918, 104-117.

A report on height and weight of Iowa children between 14 and 16, receiving working permits, comparing rural and urban children.

832. VAHL, M. Mitteilungen über das Gewicht nichterwachsener Mädchen. *Cong. period. internat. sci. med.,* Copenhagen: 1884, 120-125.

The girls of this school ranging from four to 16 years, were weighed semi-annually from 1874 to 1883, and the resulting increments and percents of gain show that there is a greater increase in growth in weight in summer than in winter.

833. VANEY, V. Relation entre le développement physique et le développement intellectual. *Bull. de la soc. libre pour l'étude de 'lenfant*, 1906, (6), 195-202.

834. VANEY, V. Le développement physique des arriérés d'école. *Bull. de la soc. libre pour l'étude psychol. de l' enf.*, 1907-08, (8), 108-114; 1909, (9), 26-29.

*835. VARIOT, G. *Clinique infantile*, 1907-08, 15 Dez., (5), 1.

Deals with the effect on height of pathological nutrition conditions.

*836. VARIOT, G. L'accroissement statural et l'accroissement pondéral chez le nouveau-né. *Presse méd. belge*, 1908, (60), 821-826. Practically the same material as published in *Ann. de méd. et chir. inf.*, 1908, (12), 447-452.

Variot (*Clinique infantile*, Dec. 15, 1908) presented a case of an infant with hypertrophy in which increase of height was less affected than increase of weight. He called this "dissociation of growth." In this article Variot shows that dissociation of growth also takes place in normal cases during the first months of life. He finds from several observations of height that infants have grown considerably within a few days after birth but have lost weight or simply reattained the birth weight. He gives four individual cases of several months' duration where height increased while weight did not.

837. VARIOT, G. Note sur la dissociation de la croissance chez les débiles. *Bull. soc. pediatrie*, 1908, (10), 193-195.

Two kinds of "dissociation of growth" are analyzed. In both the weight does not increase in the same proportion as does height and both conditions are abnormal.

838. VARIOT, G. AND CHAUMET,— Tables de croissance dressées en 1905 d'après les mensurations de 4400 enfants parisiens de 1-15 ans. *Compt. rend. d. acad. de sci. de Paris*, 1906, (142), 299-301. Also in *Bull. soc. de pédiat. de Paris*, 1906, (8), 49-58. Also *Bull. a occul. Toulouse*, 1906, 3 S., (20), 46-52.

These measurements were made on children from crèches, dispensaries, écoles maternelles, écoles communales, orphan asyl-

ums and vocational schools. A table is given for comparison with the results of Rotch and Quetelet, together with a curve representing the growth of boys and girls in weight and height.

839. VARIOT, G. AND CHAUMET,— Tables de croissance des enfants parisiens de 1 à 16 ans. *Bull. et mém. de soc. d'anthropol. de Paris,* 1906, (7), 51-65.

*840. VARIOT, G. AND FLINIAUX,— Tables des croissances comparées des nourrissons élevés au sein et au bibéron durant la première année de la vie. *Compt. rend. acad. d. sci. de Paris,* 1914, (158), 1361-1364.

This article reports with tables the average height and weight of infants 1-12 months of age. For each month there were 25 boys and 28 girls who were breast fed, 20 boys and 20 girls on mixed feeding and 41 boys and 32 girls who were artificially fed. Contrary to the usual findings, only a small difference was found between the breast fed and the artificially fed.

841. VASSILIEV,— (Materials for the Study of the Physical Development of Girls.) *Zdorovie,* 1881, (8), No. 1.

Russian, cited by Wiazemsky.

*842. VEIT, G.— (Birth Measurements of Rostock Infants). *Monatsch. f. Geburtsk. u. Frauenkrankh.,* 1855, (6), 141.

843. VERNEAU, R. Résultats anthropologiques de la mission de M. de Gironcourt en Afrique occidentale. *L'anthropologie,* 1916, (27), 47-95; 211-242; 407-430; 539-568.

A few tables of measurements on a small number of subjects.

844. VIERORDT, K. Wachstum. GERHARD: *Handbuch der Kinderkrankheiten.* Tübingen: 1877, (1), 59-91.

This is an important early treatise on the growth of the body and its parts, with copies of tables from previous investigators and references.

845. VIERORDT, K. Physiologie des Kindesalters. GERHARD: *Handbuch der Kinderkrankheiten.* Tübingen: Laupp, 1881, 219-291.

This is a general treatise on growth. It deals briefly with the diurnal variations in weight, with birth weight, with the curve of growth, with the factors that influence growth, and with the growth of the different parts of the body.

846. VIERORDT, K. *Anatomische, physiologische und physikalische Daten und Tabellen.* 3d Edition. Jena: Fischer, 1906. Pp. 622.

Contains comprehensive data and tables on the anatomical, physiological and psycho-physical phases of development, with historical material bearing directly on the problem of growth of infants, children and adults, together with numerous references.

847. VILLERMÉ, L. Mémoire sur la taille de l'homme en France. *Annal. d'hyg. publ.,* 1829, (1), 351-395.

This is a study of the height of conscripts in the French army, their age upon attaining complete development and the causes of their physical defects. It contains a table of average height and weight for each of the different *arrondissements and departments.*

848. VILLERMÉ, L. Note sur la taille moyenne des habitants de Paris et sur les proportions des difformités et infirmités qui les rendent impropres aux services militaires. *Annal. d. sci. natur.* Paris: 1829, (11), 140.

849. VINOGRADORSK-LUKERSK, L. (Examination of Growth and Weight of School Pupils by Scientific Methods). *Vestnik. obsh. hig. sudeb. i. prakt. med.,* 1894, (21), pt. 2, 67-186.

850. VOIT, C. Über die Periodicität im Gewichte der Kinder. Reprint from *Münch. med. Woch.*, 1886, (33), 129-131.

This is a discussion of Malling-Hansen's work from the point of view of the advisability of weighing children in a local institution.

*851. VOUTE, A. De voeding van den zuigeling. *Med. Weekbl.*, 1895-96, (2), 133; 197; 269; 338.

*852. WAGNER,— *Beobachtungen über Gewicht und Maase der Neugeborenen.* Diss. Königsberg: 1884.

853. WAGNER, W. Entwicklung des Kinderkörpers von der Geburt zum Abschluss des Wachstums. *Hannover Ver. Züchtungsk.*, 1911.

854. WALKER, E. W. A. The Relationship between the Body Weight and the Length of the Body (Stem Length) in Man. *J. of Physiol.*, 1915, (50), 111. *Proc. Roy. Soc.*, 1916, (89), s. B., 157-173. Same title.

A constant relationship was found between body weight and stem length. A table shows the agreement of actual measurements on 201 children with the calculated values.

855. WARNER, F. Report on the Physical and Mental Condition of 50,000 Children Seen in 106 Schools of London. *Rep. of the Commissioner, U. S. Bur. of Educ.*, 1890, (2), 1081-1138.

An important report prepared for the British Medical Association and the Charity Organization Society of London, and preliminary to the data included in the author's study of children.

856. WARNER, F. Physical Defects. *Brit. Ass'n. for the Adv. of Sci.*, 1897, (67), 427-439.

Deals principally with physical defects.

*857. WARREN, S. P. The Average Birth Weight of 2000 Confinements in the State of Maine. *Amer. J. Obstet.*, 1917, (76), 932-936.

858. WEISSE, F. S. A Study of Chest and Abdominal Measurements in Relation to Build. *Med. Rec.*, 1912, (82), 1020-1022.

Measurements of 3035 healthy adult males to whom life insurance policies had been issued. Tables of weight for each one inch increase of height between five feet three inches and six feet are given, together with other measurements. Each additional pound in weight at a given height causes a definite change in the other measurements. By using a table one can determine what should be the measurements of any man over 24 years, of any weight, whose height falls within the limits given.

859. WEISSENBERG, S. Die südrussischen Juden. *Arch. f. Anthropol.*, 1895, (23), 347-424.

Many tables of measurements are given for over 1000 subjects, age five to 75 years.

860. WEISSENBERG, S. Anthropometrische Prinzipien und Methoden. *Globus*, 1904, (89), 350.

*861. WEISSENBERG, S. Das neugeborene Kind bei den südrussischen Juden. *Globus*, 1908, (93), 85.

862. WEISSENBERG, S. Das Wachstum der Hüftbreite nach Alter und Geschlecht. *Monatsch. f. Geburtsh. u. Gynäk.*, 1909.

863. WEISSENBERG, S. Die kaukasischen Juden in anthropologischer Beziehung. *Arch. f. Anthropol.*, 1909, (8), 237-245.

864. WEISSENBERG, S. Das Wachstum des Kopfes und des Gesichts. *Jahrb. f. Kinderheilk.*, 1910, (18), 304-317.

Measurements of nine dimensions of the head on the following classes of subjects: new born, five year old, 10 year old, and 15 year old boys (25 of each), 25 10 year old girls, 50 adult women, 100 adult men, all Jewish. Tables of indices and graphs showing relative proportions are included.

865. WEISSENBERG, S. *Das Wachstum des Menschen.* Stuttgart: Strecker und Schröder, 1911. Pp. 220.

This is the most important recent publication on physical growth and contains chapters on foetal growth, the proportions of the bodies of babies, growth during the periods of childhood, the conditions influencing growth, and the laws of growth. Many authorities are quoted, numerous tables are included, and charts show the growth of different parts of the body, together with the relative heights and height increments of Jews, Russians, Englishmen, and Belgians. The author's measurements are taken on South Russian Jews.

866. WEISSENBERG, S. Armenier und Juden. *Arch. f. Anthropol.*, 1914, n. F., (13), 383-387.

This contains three tables of "Körpermerkmale."

867. WEITZEL,— (Measurements of Girls). *13. Jahresbericht der städischen höheren Mädchenschule in Uhm a. D. f. 1890-91.*

Contains measurements of 298 girls.

868. WELKNER, F. *Untersuchungen über Bau und Wachstum des menschlichen Schädels.* Leipzig: Engelmann, 1862.

869. WENGLER, J. Das Volumen und Spezifische Gewicht des menschlichen Körpers. *Pflüger's Arch. f. d. ges. Physiol.*, 1906, (115), 612.

870. WEST, G. M. Worcester School Children; Growth of Head, Body, and Face. *Science*, 1893, (21), 2-4.

This investigation is based on several measurements including the weight and height of 3352 children between the ages of five and 21 in public and private schools of Worcester.

871. WEST, G. M. The Anthropometry of American School Children. *Mem. Intern. Cong. Anthropol.*, 1893, Chicago: 1894, 50-58.

872. WEST, G. M. Anthropometrische Untersuchungen über die Schulkinder in Worcester, Mass. *Arch. f. Anthropol.*, 1894, (22), 13-48.

This is a more detailed and elaborate study of the data included in the previous investigation.

873. WEST, G. M. Observation of the Relation of Physical Development to Intellectual Ability, Made on the School Children of Toronto, Canada. *Science*, N. S., 1896, (4), 156-159.

In this investigation the results are opposed to those of Porter. In place of using school grade as the criterion index of precocity, West uses the teacher's judgment, and appends a number of curves without figures, giving the relative sizes of good and poor students.

874. WHIPPLE, G. M. *Manual of Mental and Physical Tests.* Baltimore: Warwick and York, 1915. Pp. 365 (vol. 1) +336 (vol. 2).

From the standpoint of education this is the most important contribution now accessible on the general subjects of mental and physical tests. Chapter II treats of the general rules for the conduct of tests; Chapter III, the treatment of measures; Chapter IV, physical tests. The averages of Boas, Burk and Smedley are used as norms.

875. WHYTE, G. D. (Physical Measurements of Chinese) *Nat. Med. J., China,* 1917, (3), 101-113.

876. WHYTE, G. D. The Height, Weight and Chest Measurements of Healthy Chinese. *China Med. J.*, 1918, (32), 210-216; 322-328.

This is a report of the research committee of the China Medical Missionary Association, which undertook to establish norms for the Chinese people. Height, weight, circumference of the head and two indices (height-weight and Pignet) are reported on 1741

males from two provinces of South China and 202 females. A curve showing the average height, 10-19 years, of males and females is given and the Chinese children are compared with Scotch boys and girls. This comparison shows the Chinese to be both smaller and lighter.

877. WIAZEMSKY, N. W. *Ismenenia organisma v periode sformirorania.* St. Petersburg: 1902.

Modifications of organisms during the period of puberty from the age of 10 to 20. This is an important study containing 278 tables and 43 diagrams.

878. WIAZEMSKY, N. W. *Influence de différents facteurs sur la croissance du corps humain.* Paris: Maloine, 1907. Pp. 394.

This is an analysis of previous work with additional data on 1808 pupils of a school for boys at St. Petersburg. Chapters are included on height, span of arms, circumference of chest, weight, muscular strength and on the diameters of the head. There are numerous comparative tables and 39 graphs showing the average annual increments in various measurements from 11 to 18 years. The author refers to many Russian works not usually mentioned in the literature of physical development, but the citations are not specific enough to make these studies accessible.

879. WIENER, C. *Über das Wachstum des menschlichen Körpers.* Karlsruhe: 1890. Pp. 23.

A monograph containing curves and tables giving the annual measurements in height, weight and head girth of Wiener's four sons from birth to maturity. A very valuable contribution.

880. WIETLIND,— *Iagttagelsar rörande helsotilstandet i nogra af Göteborgs verkskolor.* Goteborg, Sweden: 1878.

881. WILLIAMS, E. H. Tables Indicating Progressive Increase of Development in Boys Examined for Naval Service and Some Remarks on the Growth of the Human Body. *Statis Rep. Health Brit. Navy,* 1902, 149-172.

*882. WINCKEL,— Untersuchungen über die Gewichtsverhältnisse bei 100 Neugeborenen in den ersten 10 Tagen nach der Geburt. *Monatsch. f. Geburtsk.,* 1862, (19), 416-442.

Contains the results of daily weighing.

883. WISSLER, C. Growth of Boys; Correlations for the Annual Increments. *Amer. Anthropol.,* 1903, N. S., (5), 81-88.

This is a very important contribution to the study of growth based on the correlation of increments of growth in height and weight for 72 boys for the periods from 12 to 17 years of age. "The real problem in studies of growth is the determination of the annual increments during the period of growth for each degree of adult stature. Until we have sufficient measurements to tell us how the tall men and likewise the short men grow in boyhood, we can form no idea of the significance of any given part of the growing period. Thus far our knowledge of growth, as determined by physical measurements of children, is based on average statures obtained by single measurements of large groups of children. We thus gain a certain general curve of growth from which we infer certain tendencies to periodic growth. In all such measurements we have ample means for determining the variation between individuals at each period of life, but no way of estimating the degree of variation in the same individual from year to year. Thus, while we know that the average maximum increase in the stature of boys occurs about the fourteenth year of life, we have no means of knowing how many boys reach their maximum before or after this point."

No imprints of these tables (a. b. c. d. e.) were made and the data are inaccessible.

884. Witt, J. *De proportiën van het menschelijk ligchaam afgebeeld, met de beschrijving, in het Nederduitsch en Fransch.* Amsterdam.

*885. Witzinger,— *Über die Stirnfontanelle und den horizontalen Umfang des Kopfes beim Neugeborenen.* Diss. Bern: 1876.
Also reports weight of the new born.

*886. Wolff, F. *Über die Gewichtsverhältnisse Neugeborener.* Diss. Munchen; 1883.

887. Wood, E. E. Notes on Oriental Babies. *Amer. Anthropol.*, 1903, N. S., (5), 659-666.
This article mentions the work of other investigators of Oriental races but gives no references. It contains tables with measurements on 61 Chinese and 22 Japanese, aged one day to seven years. The data for each age are too few to furnish reliable norms.

888. Wood, M. A. *Anthropometric Table Compiled from the Measurements of 1100 Wellesley College Students Arranged According io Bodily Heights.* 1890. (No imprint).

889. Wood, M. A. *Statistical Tables* (concerning the class of 1891 of Wellesley college, numbering 104 women.) (No imprint).

890. Wood, M. A. *Statistical Tables* (showing certain measurements of 40 freshmen of Wellesley college at the beginning of November 1891, and the end of May, 1892, after six month of gymnasium training.) 1892. (No imprint).

891. Wood, M. A. Six Comparative Tables (showing records of class crews receiving training in gymnasium and on the lake; of 20 students receiving training in the gymnasium; and of 20 students receiving no training in the gymnasium.) *Wellesley College, President's Rep.*, Boston: 1893, 35-40.

892. Wood, M. A. *Anthropometric Table, Arranged After the Method of Percentile Grades, of the Measurements of 1500 Wellesley College Students.* 1903. (No imprint).

893. Wood, T. D. *Height and Weight Table for Girls and Boys.* New York: New York Child Health Organization, 1918.
A card of norms for weight at years 5-18 arranged to correspond to the appropriate height.

894. Woronichin, N. Fortlaufende Wägungen während der Dentition. *Jahrb. f. Kinderheilk.*, 1880-81, (16), 133-143.
This article reports continuous measurements from 6 months up to the age of the breaking through of the last milk tooth. Although only one subject was used, a boy, the data on diet, and language development are very full and make the study one of unusual interest.

895. Wright, E. A. Physical Training of Post-Adolescent Girls. *J. of Nat. Educ. Ass'n. of the U. S.*, 1910, 942-946.
A general discussion on growth and physical training.

896. v. Wullerstorf-Urbair, B. *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857-59.* Anthropologischer Theil. 2te Abtheilung. Körpermessungen an individuen verschiedener Menschenrassen vorgenommen durch Dr. Karl Scherzer und Dr. Eduard Schwarz, bearbeitet von Dr. Weisbach. Wein: 1867, (4).

897. Wylie, A. R. T. Investigation Concerning the Weight and Height of Feeble-Minded Children. *J. of Psycho-Asthen.*, 1899, (4), 47-57. See also, 1900, (5), No. 5; 1902, (7), No. 1.

This investigation is based on 161 boys and girls from Minnesota. The number was later increased to 400.

898. WYLIE, A. R. T. Contribution to the Study of the Growth of the Feeble-Minded in Height and Weight. *J. of Psycho-Asthen.*, 1903, (8), 1-7.

A study of the height and weight of feeble-minded children, with the conclusion that feeble-minded children are subnormal in height and weight. The feeble-minded, in height and weight, approximate the normal most closely at 10 years of age. A high mean variation is characteristic of the feeble-minded.

899. YATSUTA, K. Z. (Anthropometric Study of Enlisted Men) *Voyenno med. J.*, 1914, (240), Med.-spec., part, 381-389.

Russian.

900. YOUNG, J. E. Supernormal Environment in its Relation to the Normal Child. *Trans. 4th Int. Cong. on Sch. Hyg.* Buffalo: 1913, (2), 17-30.

Children of the University of Chicago School of Education (404 girls and 201 boys) were examined for this report. Height, weight, vital capacity, blood pressure, and haemoglobin are reported for ages six to 18 and compared with measures of children from other social groups. The children of the rich are found to be taller and heavier and to have greater lung capacity than public school children. The measurements are peculiar in that the pre-pubertal increase in the development of girls over that of boys was not noted.

901. ZACHARIAS, O. Über Periodicität in der Gewichtszunahme bei Kindern. *Monatl. Mitt. a. d. gesamtgeb. d. Naturw.* Berlin: 1889, 35-37; 57-60.

A general discussion with particular reference to the work of Malling-Hansen.

902. ZAHOR, J. W. Z. *(Report on the Investigation of Certain Physical Conditions of School Children of Prague, Including Stature, Weight, Eye Defects, and Spinal Curvature.)* Prague: 1907. Pp. 44.

903. ZEINER-HENRIKSEN, K. (Growth of School Children.) *Nordsk. Mag. f. Laegevidensk.*, 1918, (79), 52-60. Abstr. in *J. Amer. Med. Ass'n.*, 1918, (70), 742.

This gives averages for 1333 boys and girls seven to 14 years, measured in the Horton, Norway, schools.

904. ZEINER-HENRIKSEN, K. (The Growth of School Children) Part II. *Nordsk. Mag. f. Laegevidensk.*, 1920, (81), 262-271.

A report of increments in height between February and September 1916 for boys and girls at the ages seven to 14. Four tables and two graphs show the percentile distribution of gains in height, standard deviation and variation coefficient. The usual pubertal difference in the growth of the sexes is noted.

905. ZEISING, A. *Neue Lehre von den Proportionen des menschlichen Körpers.* Leipzig: 1854.

906. ZEISING, A. Über die Metamorphozen in den Verhältnissen der Menschlichen Gestalt von der Geburt bis zur Vollendung des Längenwachstums. *Verhandl. der Kais. Leop.-Car. Akad. d. Naturforscher*, 1858, (18), Part 2, 783.

This article supports the thesis that all the proportions of the body are related to each other in the ratio of the golden mean, and that given a few measurements, all the others can be derived by the use of this ratio. Some actual measurements are published for 10 individuals, for each age from one year to adult.

907. ZEISING, A. *Die Metamorphosen in den Verhältnissen der menschlichen Gestalt*, & c. Bonn: 1859.

It is pointed out in this article that growth does not consist merely in a simple increase of the various dimensions, but in a continuous change of the relations between parts of the body always approximating the golden section.

908. ZEISING, A. Über die Metamorphosen in den Verhältnissen der menschlichen Gestalt von der Geburt bis zur Vollendung des Längenwachstums. *Abhandl. d. Bonner Acad.*, (26).

*909. ZELTNER, E. Die Beziehung zwischen Brustwachstum, Schädelwachstum und Körpergewichtzunahme bei Säuglinge. *Jahrb. f. Kinderheilk.*, 1911, (24), 421-428.

This presents individual curves of 64 infants, some normal, some in various pathological conditions, for the three measurements listed. A few of the curves extend for over a year. The three measurements are found to bear a constant relation to each other, the parallel course of development of chest circumference and weight being especially noticeable.

910. ZHBANKOFF,— (The Influence of the Common School on the Physical Development of Pupils.) *Vestnik obsh. hig. sudeb. i. prakt. med.*, 1889, (1), 147-194.

Russian, cited by Sack. See also *Messenger for Legal Medicine*, 1889, (3).

911. ZIRKLE, H. W. Interdependence of the Mental and Physical. In ZIRKLE: *Medical Inspection of Schools.* (University of Colorado Bulletin), 1902, (1), 3-23.

Contains many statistical tables from other authors, including Bowditch, Warner, Christopher, and others, with suggestions for measuring and an anthropological chart.

PART VII

CHAPTER XII

English Equivalents for Metric Units

1. TABLE—CENTIMETERS TO INCHES

Centi-meters	Inches	Centi-meters	Inches	Centi-meters	Inches	Centi-meters	Inches
1	.39	46	18.11	91	35.83	136	53.54
2	.79	47	18.50	92	36.22	137	53.94
3	1.18	48	18.90	93	36.61	138	54.33
4	1.57	49	19.29	94	37.01	139	54.72
5	1.97	50	19.69	95	37.40	140	55.12
6	2.36	51	20.08	96	37.80	141	55.51
7	2.76	52	20.47	97	38.19	142	55.91
8	3.15	53.	20.87	98	38.58	143	56.30
9	3.54	54	21.26	99	38.98	144	56.69
10	3.94	55	21.65	100	39.37	145	57.09
11	4.33	56	22.05	101	39.76	146	57.48
12	4.72	57	22.44	102	40.16	147	57.87
13	5.12	58	22.83	103	40.55	148	58.27
14	5.51	59	23.23	104	40.94	149	58.66
15	5.91	60	23.62	105	41.34	150	59.06
16	6.30	61	24.02	106	41.73	151	59.45
17	6.69	62	24.41	107	42.13	152	59.84
18	7.09	63	24.80	108	42.52	153	60.24
19	7.48	64	25.20	109	42.91	154	60.63
20	7.87	65	25.59	110	43.31	155	61.02
21	8.27	66	25.98	111	43.70	156	61.42
22	8.66	67	26.38	112	44.09	157	61.81
23	9.06	68	26.77	113	44.49	158	62.20
24	9.45	69	27.17	114	44.88	159	62.60
25	9.84	70	27.56	115	45.28	160	62.99
26	10.24	71	27.95	116	45.67	161	63.39
27	10.63	72	28.35	117	46.06	162	63.78
28	11.02	73	28.74	118	46.46	163	64.17
29	11.42	74	29.13	119	46.85	164	64.57
30	11.81	75	29.53	120	47.24	165	64.96
31	12.20	76	29.92	121	47.64	166	65.35
32	12.60	77	30.32	122	48.03	167	65.75
33	12.99	78	30.71	123	48.43	168	66.14
34	13.39	79	31.10	124	48.82	169	66.54
35	13.78	80	31.50	125	49.21	170	66.93
36	14.17	81	31.89	126	49.61	171	67.32
37	14.57	82	32.28	127	50.00	172	67.72
38	14.96	83	32.68	128	50.39	173	68.11
39	15.35	84	33.07	129	50.79	174	68.50
40	15.75	85	33.46	130	51.18	175	68.90
41	16.14	86	33.86	131	51.57	176	69.29
42	16.54	87	34.25	132	51.97	177	69.69
43	16.93	88	34.65	133	52.36	178	70.08
44	17.32	89	35.04	134	52.76	179	70.47
45	17.72	90	35.43	135	53.15	180	70.87

2. TABLE—KILOGRAMS TO POUNDS

Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds
1	2.20	21	46.30	41	90.39	61	134.48
2	4.41	22	48.50	42	92.59	62	136.69
3	6.61	23	50.71	43	94.80	63	138.89
4	8.82	24	52.91	44	97.00	64	141.09
5	11.02	25	55.12	45	99.21	65	143.30
6	13.23	26	57.32	46	101.41	66	145.50
7	15.43	27	59.52	47	103.62	67	147.71
8	17.64	28	61.73	48	105.82	68	149.91
9	19.84	29	63.93	49	108.03	69	152.12
10	22.05	30	66.14	50	110.23	70	154.32
11	24.25	31	68.34	51	112.44	71	156.53
12	26.46	32	70.55	52	114.64	72	158.73
13	28.66	33	72.75	53	116.84	73	160.94
14	30.86	34	74.96	54	119.05	74	163.14
15	33.07	35	77.16	55	121.25	75	165.35
16	35.27	36	79.37	56	123.46	76	167.55
17	37.48	37	81.57	57	125.66	77	169.75
18	39.68	38	83.78	58	127.87	78	171.96
19	41.89	39	85.98	59	130.07	79	174.16
20	44.09	40	88.18	60	132.28	80	176.37

3. TABLE—DECILITERS TO CUBIC INCHES

Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches
.01	.06	.26	1.59	.51	3.11	.76	4.64
.02	.12	.27	1.65	.52	3.17	.77	4.70
.03	.18	.28	1.71	.53	3.23	.78	4.76
.04	.24	.29	1.77	.54	3.30	.79	4.82
.05	.31	.30	1.83	.55	3.36	.80	4.88
.06	.37	.31	1.89	.56	3.42	.81	4.94
.07	.43	.32	1.95	.57	3.48	.82	5.00
.08	.49	.33	2.01	.58	3.54	.83	5.06
.09	.55	.34	2.07	.59	3.60	.84	5.13
.10	.61	.35	2.14	.60	3.66	.85	5.19
.11	.67	.36	2.20	.61	3.72	.86	5.25
.12	.73	.37	2.26	.62	3.78	.87	5.31
.13	.79	.38	2.32	.63	3.84	.88	5.37
.14	.85	.39	2.38	.64	3.91	.89	5.43
.15	.92	.40	2.44	.65	3.97	.90	5.49
.16	.98	.41	2.50	.66	4.03	.91	5.55
.17	1.04	.42	2.56	.67	4.09	.92	5.61
.18	1.10	.43	2.62	.68	4.15	.93	5.68
.19	1.16	.44	2.68	.69	4.21	.94	5.74
.20	1.22	.45	2.75	.70	4.27	.95	5.80
.21	1.28	.46	2.81	.71	4.33	.96	5.86
.22	1.34	.47	2.87	.72	4.39	.97	5.92
.23	1.40	.48	2.93	.73	4.45	.98	5.98
.24	1.46	.49	2.99	.74	4.52	.99	6.04
.25	1.53	.50	3.05	.75	4.58	1.00	6.10
1	6.10	11	67.12	21	128.15	31	189.17
2	12.20	12	73.23	22	134.25	32	195.27
3	18.31	13	79.33	23	140.35	33	201.37
4	24.41	14	85.43	24	146.45	34	207.47
5	30.51	15	91.53	25	152.56	35	213.58
6	36.61	16	97.64	26	158.66	36	219.68
7	42.72	17	103.74	27	164.76	37	225.78
8	48.82	18	109.84	28	170.86	38	231.88
9	54.92	19	115.94	29	176.96	39	237.99
10	61.02	20	122.04	30	183.07	40	244.09

4. TABLE—INCHES TO CENTIMETERS

Inches	Centimeters	Inches	Centimeters	Inches	Centimeters	Inches	Centimeters
.01	.03	.26	.66	.51	1.30	.76	1.93
.02	.05	.27	.69	.52	1.32	.77	1.96
.03	.08	.28	.71	.53	1.35	.78	1.98
.04	.10	.29	.74	.54	1.37	.79	2.01
.05	.13	.30	.76	.55	1.40	.80	2.03
.06	.15	.31	.79	.56	1.42	.81	2.06
.07	.18	.32	.81	.57	1.45	.82	2.08
.08	.20	.33	.84	.58	1.47	.83	2.11
.09	.23	.34	.86	.59	1.50	.84	2.13
.10	.25	.35	.89	.60	1.52	.85	2.16
.11	.28	.36	.91	.61	1.55	.86	2.18
.12	.31	.37	.94	.62	1.57	.87	2.21
.13	.33	.38	.97	.63	1.60	.88	2.24
.14	.36	.39	.99	.64	1.63	.89	2.26
.15	.38	.40	1.02	.65	1.65	.90	2.29
.16	.41	.41	1.04	.66	1.68	.91	2.31
.17	.43	.42	1.07	.67	1.70	.92	2.34
.18	.46	.43	1.09	.68	1.73	.93	2.36
.19	.48	.44	1.12	.69	1.75	.94	2.39
.20	.51	.45	1.14	.70	1.78	.95	2.41
.21	.53	.46	1.17	.71	1.80	.96	2.44
.22	.56	.47	1.19	.72	1.83	.97	2.46
.23	.58	.48	1.22	.73	1.85	.98	2.49
.24	.61	.49	1.24	.74	1.88	.99	2.52
.25	.64	.50	1.27	.75	1.91	1.00	2.54
17	43.18	32	81.28	47	119.38	62	157.48
18	45.72	33	83.82	48	121.92	63	160.02
19	48.26	34	86.36	49	124.46	64	162.56
20	50.80	35	88.90	50	127.00	65	165.10
21	53.34	36	91.44	51	129.54	66	167.64
22	55.88	37	93.98	52	132.08	67	170.18
23	58.42	38	96.52	53	134.62	68	172.72
24	60.96	39	99.06	54	137.16	69	175.26
25	63.50	40	101.60	55	139.70	70	177.80
26	66.04	41	104.14	56	142.24	71	180.34
27	68.58	42	106.68	57	144.78	72	182.88
28	71.12	43	109.22	58	147.32	73	185.42
29	73.66	44	111.76	59	149.86	74	187.96
30	76.20	45	114.30	60	152.40	75	190.50
31	78.74	46	116.84	61	154.94	76	193.04

5. TABLE—SQUARE INCHES TO SQUARE MILLIMETERS

Square Inches	Square Milli-meters	Square Inches	Square Milli-meters	Square Inches	Square Milli-meters	Square Inches	Square Milli-meters
.01	6.45	.26	167.74	.51	329.03	.76	490.32
.02	12.90	.27	174.19	.52	335.48	.77	496.77
.03	19.35	.28	180.64	.53	341.93	.78	503.22
.04	25.81	.29	187.10	.54	348.39	.79	509.68
.05	32.26	.30	193.55	.55	354.84	.80	516.13
.06	38.71	.31	200.00	.56	361.29	.81	522.58
.07	45.16	.32	206.45	.57	367.74	.82	529.03
.08	51.61	.33	212.90	.58	374.19	.83	535.48
.09	58.06	.34	219.35	.59	380.64	.84	541.93
.10	64.52	.35	225.81	.60	387.10	.85	548.39
.11	70.97	.36	232.26	.61	393.55	.86	554.84
.12	77.42	.37	238.71	.62	400.00	.87	561.29
.13	83.87	.38	245.16	.63	406.45	.88	567.74
.14	90.32	.39	251.61	.64	412.90	.89	574.19
.15	96.77	.40	258.06	.65	419.35	.90	580.64
.16	103.23	.41	264.52	.66	425.81	.91	587.10
.17	109.68	.42	270.97	.67	432.26	.92	593.55
.18	116.13	.43	277.42	.68	438.71	.93	600.00
.19	122.58	.44	283.87	.69	445.16	.94	606.45
.20	129.03	.45	290.32	.70	451.61	.95	612.90
.21	135.48	.46	296.77	.71	458.06	.96	619.35
.22	141.94	.47	303.23	.72	464.52	.97	625.81
.23	148.39	.48	309.68	.73	470.97	.98	632.26
.24	154.84	.49	316.13	.74	477.42	.99	638.71
.25	161.29	.50	322.58	.75	483.87	1.00	645.16

6. TABLE—CUBIC INCHES TO DECILITERS

Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters	Cubic Inches	Deci-liters
1	.16	51	8.36	101	16.55	151	24.75	201	32.94
2	.33	52	8.52	102	16.72	152	24.91	202	33.10
3	.50	53	8.69	103	16.88	153	25.07	203	33.27
4	.66	54	8.85	104	17.04	154	25.24	204	33.43
5	.82	55	9.01	105	17.21	155	25.40	205	33.59
6	.98	56	9.18	106	17.37	156	25.57	206	33.76
7	1.15	57	9.34	107	17.54	157	25.73	207	33.92
8	1.31	58	9.51	108	17.70	158	25.89	208	34.09
9	1.48	59	9.67	109	17.86	159	26.06	209	34.25
10	1.64	60	9.83	110	18.03	160	26.22	210	34.41
11	1.80	61	10.00	111	18.19	161	26.38	211	34.58
12	1.97	62	10.16	112	18.35	162	26.55	212	34.74
13	2.13	63	10.32	113	18.52	163	26.71	213	34.91
14	2.29	64	10.49	114	18.68	164	26.88	214	35.07
15	2.46	65	10.65	115	18.85	165	27.04	215	35.23
16	2.62	66	10.82	116	19.01	166	27.20	216	35.40
17	2.79	67	10.98	117	19.17	167	27.37	217	35.56
18	2.95	68	11.14	118	19.34	168	27.53	218	35.73
19	3.11	69	11.31	119	19.50	169	27.70	219	35.89
20	3.28	70	11.47	120	19.67	170	27.86	220	36.05
21	3.44	71	11.64	121	19.83	171	28.02	221	36.22
22	3.61	72	11.80	122	19.99	172	28.19	222	36.38
23	3.77	73	11.96	123	20.16	173	28.35	223	36.54
24	3.93	74	12.13	124	20.32	174	28.51	224	36.71
25	4.10	75	12.29	125	20.48	175	28.68	225	36.87
26	4.26	76	12.46	126	20.65	176	28.84	226	37.04
27	4.43	77	12.62	127	20.81	177	29.01	227	37.20
28	4.59	78	12.78	128	20.98	178	29.17	228	37.36
29	4.75	79	12.95	129	21.14	179	29.33	229	37.53
30	4.92	80	13.11	130	21.30	180	29.50	230	37.69
31	5.08	81	13.27	131	21.47	181	29.66	231	37.86
32	5.24	82	13.44	132	21.63	182	29.83	232	38.02
33	5.41	83	13.60	133	21.80	183	29.99	233	38.18
34	5.57	84	13.77	134	21.96	184	30.15	234	38.35
35	5.74	85	13.93	135	22.12	185	30.32	235	38.51
36	5.90	86	14.09	136	22.29	186	30.48	236	38.68
37	6.06	87	14.26	137	22.45	187	30.65	237	38.84
38	6.28	88	14.42	138	22.62	188	30.81	238	39.00
39	6.39	89	14.59	139	22.78	189	30.97	239	39.17
40	6.56	90	14.75	140	22.94	190	31.14	240	39.33
41	6.72	91	14.91	141	23.11	191	31.30	241	39.49
42	6.84	92	15.08	142	23.27	192	31.46	242	39.66
43	7.05	93	15.24	143	23.43	193	31.63	243	39.82
44	7.21	94	15.40	144	23.60	194	31.79	244	39.99
45	7.37	95	15.57	145	23.76	195	31.96	245	40.15
46	7.54	96	15.73	146	23.93	196	32.12	246	40.31
47	7.70	97	15.90	147	24.09	197	32.28	247	40.48
48	7.87	98	16.06	148	24.25	198	32.45	248	40.64
49	8.03	99	16.22	149	24.42	199	32.61	249	40.81
50	8.19	100	16.39	150	24.58	200	32.78	250	40.97

7. TABLE—POUNDS TO KILOGRAMS

Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams	Pounds	Kilo-grams
.1	.05	.4	.18	.7	.32	1.0	.45
.2	.09	.5	.23	.8	.36		
.3	.14	.6	.27	.9	.41		
5	2.27	50	22.68	95	43.09	140	63.50
6	2.72	51	23.13	96	43.54	141	63.96
7	3.18	52	23.59	97	44.00	142	64.41
8	3.63	53	24.04	98	44.45	143	64.86
9	4.08	54	24.49	99	44.91	144	65.32
10	4.54	55	24.95	100	45.36	145	65.77
11	4.99	56	25.40	101	45.81	146	66.22
12	5.44	57	25.85	102	46.27	147	66.68
13	5.90	58	26.31	103	46.72	148	67 13
14	6.35	59	26.76	104	47.17	149	67.58
15	6.80	60	27.22	105	47.63	150	68.04
16	7.26	61	27.67	106	48.08	151	68.49
17	7.71	62	28.12	107	48.53	152	68.95
18	8.17	63	28.58	108	48.99	153	69.40
19	8.62	64	29.03	109	49.44	154	69.85
20	9.07	65	29.48	110	49.89	155	70.31
21	9.53	66	29.94	111	50.35	156	70.76
22	9.98	67	30.39	112	50.80	157	71.21
23	10.43	68	30.84	113	51.26	158	71.67
24	10.89	69	31.30	114	51.71	159	72.12
25	11.34	70	31.75	115	52.16	160	72.57
26	11.79	71	32.20	116	52.62	161	73.03
27	12.25	72	32.66	117	53.07	162	73.48
28	12.70	73	33.11	118	53.52	163	73.94
29	13.15	74	33.57	119	53.98	164	74.39
30	13.61	75	34.02	120	54.43	165	74.84
31	14.06	76	34.47	121	54.88	166	75.30
32	14.51	77	34.93	122	55.34	167	75.75
33	14.97	78	35.38	123	55.79	168	76.20
34	15.42	79	35.83	124	56.25	169	76.66
35	15.88	80	36.29	125	56.70	170	77.11
36	16.33	81	36.74	126	57.15	171	77.56
37	16.78	82	37.19	127	57.61	172	78.02
38	17.24	83	37.65	128	58.06	173	78.47
39	17.69	84	38.10	129	58.51	174	78.92
40	18.14	85	38.56	130	58.97	175	79.38
41	18.60	86	39.01	131	59.42	176	79.83
42	19.05	87	39.46	132	59.87	177	80.29
43	19.50	88	39.92	133	60.33	178	80.74
44	19.96	89	40.37	134	60.78	179	81.19
45	20.41	90	40.82	135	61.23	180	81.65
46	20.87	91	41.28	136	61.69	181	82.10
47	21.32	92	41.73	137	62.14	182	82.55
48	21.77	93	42.18	138	62.60	183	83.01
49	22.23	94	42.64	139	63.05	184	83.46

A PRACTICAL SCORE CARD

TO DETERMINE THE NORMAL GROWTH OF CHILDREN (English Units of Measure)

Average Weight in Pounds	1½ mos.	4½ mos.	7½ mos.	10½ mos.	13½ mos.	16½ mos.	19½ mos.	24 mos.	2½ yrs.	3 yrs.	3½ yrs.	4 yrs.	4½ yrs.	5 yrs.
Boys:	11.4	15.6	18.4	20.1	21.6	23.0	24.5	26.0	28.3	30.5	32.6	34.6	35.8	37.6
Girls:	10.2	14.5	17.6	19.0	20.2	21.3	23.3	24.9	27.1	29.1	31.1	32.7	34.2	36.3
Average Height in Inches														
Boys:	22.8	25.5	27.3	28.6	29.9	31.1	32.3	33.6	35.0	36.7	38.2	39.4	40.5	41.8
Girls:	22.1	24.9	27.0	28.1	29.2	30.4	31.8	33.0	34.7	36.2	37.7	39.0	40.1	41.4
Weight-Height Index = $\frac{\text{Height}}{\text{Weight}}$														
Boys: Maximum Index 15% above av. normal	.58	.70	.77	.81	.83	.84	.87	.89	.93	.95	.98	1.01	1.01	1.04
Average Normal Index	.50	.61	.67	.70	.72	.73	.76	.77	.81	.83	.85	.88	.88	.90
Minimum Index 15% below av. normal	.42	.52	.57	.59	.61	.62	.65	.65	.69	.71	.72	.75	.75	.76
Girls: Maximum Index 15% above av. normal	.53	.67	.75	.77	.79	.81	.84	.86	.90	.92	.94	.97	.98	1.01
Average Normal Index	.46	.58	.65	.67	.69	.70	.73	.75	.78	.80	.82	.84	.85	.88
Minimum Index 15% below av. normal	.39	.49	.55	.57	.59	.59	.62	.64	.66	.68	.70	.71	.72	.75
Gain in Weight in Ounces per month	Birth–1½ m	1½–4½ mos.	4½–7½ mos.	7½–10½ mos.	10½–13½ m	13½–16½ m	16½–19½ m	19½–24 m	24m–2½ yr.	2½–3 yrs.	3–3½ yrs.	3½–4 yrs.	4–4½ yrs.	4½–5 yrs.
Boys: Maximum Gain	38	28	19	11	10	9	10	6	8	8	8	6	4	6
Average Normal Gain	30	22	15	9	8	7	8	5	6	6	6	5	3	5
Minimum Gain	22	16	11	7	6	5	6	4	4	4	4	4	2	4
Girls: Maximum Gain	35	29	21	9	8	8	14	8	8	6	6	5	5	8
Average Normal Gain	28	23	17	7	6	6	11	6	6	5	5	4	4	6
Minimum Gain	21	17	13	5	4	4	8	4	4	4	4	3	3	4

A PRACTICAL SCORE CARD (Continued)

	5½ yrs.	6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.	12 yrs.	13 yrs.	14 yrs.	15 yrs.	16 yrs.	17 yrs.
Average Weight in Pounds													
Boys:	39.6	45.2	50.6	55.3	60.7	67.2	73.1	77.7	88.4	98.3	109.4	120.6	128.2
Girls:	38.1	42.6	48.0	53.8	59.7	67.2	74.1	83.9	96.2	107.2	115.5	120.6	121.8
Average Height in Inches													
Boys:	43.0	45.4	47.8	49.8	51.5	53.5	55.3	56.9	59.3	61.8	64.1	66.7	67.6
Girls:	42.2	44.3	46.8	49.1	51.1	53.1	55.3	57.6	60.1	61.8	62.7	63.6	63.6
Weight-Height Index $= \frac{\text{Weight}}{\text{Height}}$													
Boys: Maximum Index 15% above av. normal	1.06	1.14	1.21	1.28	1.35	1.44	1.52	1.56	1.71	1.83	1.96	2.07	2.17
Average Normal Index	.92	.99	1.05	1.11	1.17	1.25	1.32	1.36	1.49	1.59	1.70	1.80	1.89
Minimum Index 15% below av. normal	.78	.84	.89	.94	.99	1.06	1.12	1.16	1.27	1.35	1.44	1.53	1.61
Girls: Maximum Index 15% above av. normal	1.04	1.10	1.17	1.25	1.33	1.45	1.53	1.67	1.84	1.99	2.12	2.17	2.20
Average Normal Index	.90	.96	1.02	1.09	1.16	1.26	1.33	1.45	1.60	1.73	1.84	1.89	1.91
Minimum Index 15% below av. normal	.76	.82	.87	.93	.99	1.07	1.13	1.23	1.36	1.47	1.56	1.61	1.62
Gain in Weight in Ounces per month	5–5½ yrs.	5½–6 yrs.	6–7 yrs.	7–8 yrs.	8–9 yrs.	9–10 yrs.	10–11 yrs.	11–12 yrs.	12–13 yrs.	13–14 yrs.	14–15 yrs.	15–16 yrs.	16 17 yrs.
Boys: Maximum Gain	6	9	9	8	9	11	10	8	18	16	19	19	13
Average Normal Gain	5	7	7	6	7	9	8	6	14	13	15	15	10
Minimum Gain	4	5	5	4	5	7	6	4	10	10	11	11	7
Girls: Maximum Gain	6	8	9	10	10	13	11	16	20	19	14	9	3
Average Normal Gain	5	6	7	8	8	10	9	13	16	15	11	7	2
Minimum Gain	4	4	5	6	6	7	7	10	12	11	8	5	1

Data gathered by Federal Children's Bureau and Iowa Child Welfare Research Station.

Data selected from 18,770 Iowa boys and 18,188 Iowa girls from 1½ months to six years of age.

From six years to 17 years inclusive the measurements are from Horace Mann School on an average of 125 boys and 125 girls semi-annually for periods of eight years or more (10,000 measurements). All children were nude. No measurements were more than three months from exact age.

For children under 24 months to six years, two pounds; from six to 10 years, 2½ pounds; from 10 years to 12 years, three pounds; and from 12 to 17 years, 3¾ pounds.

A well developed tall or short child should approach within 15% of the weight-height index for the chropological age to which the child's height corresponds.

FIRST SERIES NO. 37 NOVEMBER, 1920

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 2

A SURVEY OF MUSICAL TALENT IN THE PUBLIC SCHOOLS

by

CARL E. SEASHORE

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rates of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918.

UNIVERSITY OF IOWA STUDIES
IN CHILD WELFARE

PROFESSOR BIRD T. BALDWIN, PH. D., Editor

FROM THE IOWA CHILD WELFARE RESEARCH STATION

VOLUME I NUMBER 2

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REPRESENTING THE EXAMINATION OF CHILDREN OF THE FIFTH AND THE EIGHTH GRADES IN THE PUBLIC SCHOOLS OF DES MOINES, IOWA WITH THE AUTHOR'S MEASURES OF MUSICAL TALENT

by

CARL E. SEASHORE

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EDITOR'S FOREWORD

The psychology of individual differences has made significant progress during the past ten years. In *A Survey of Musical Talent in the Public Schools,* Professor Seashore makes a marked advance in the applications of psychology by formulating scientific means for analyzing and evaluating special abilities in musical talent: by establishing norms for fifth and eighth grade children; by standardizing methods, apparatus, and technique for group procedure in schools; by presenting fundamental principles for discovering musical talent and conserving musical capacity; and by developing a science of vocational and avocational guidance within this field.

This survey was made under the auspices of the Iowa Child Welfare Research Station, which is organizing a comprehensive program for the investigation of individual traits and abilities of normal children with particular reference to the earlier ages. The editor is glad to present this monograph by a recognized authority as a model of one type of applied scientific procedure in which the Station is engaged. The requests for this study which already have been received from this country and abroad assure it a wide field of usefulness.

BIRD T. BALDWIN

August 30, 1920

A SURVEY OF MUSICAL TALENT IN THE PUBLIC SCHOOLS

INTRODUCTION

The first survey employing the group of tests now called "Measures of Musical Talent" was made in Charles City, Iowa, in 1917 where we surveyed the grammar grades in the public schools. Immediately thereafter a similar survey was made upon the grammar grades of all of the children in Sioux City and Red Oak, Iowa, and upon the grammar grades in the Wyman School, which is the training school for the Teachers College in St. Louis.

In these first surveys the tests were made with the original laboratory instruments; namely, tuning forks, an audiometer, a time-sense apparatus, and musical instruments. While these experiments were of great value in helping us to adjust procedure to actual situations in the school, and are of some historical significance, they have not been published, because we later adopted the plan of putting the test material on phonograph records. Since the original instruments have been described elsewhere and are now abandoned for school use, and the phonograph records are to constitute the standard test material, we have chosen these experiments in Des Moines for the first general report of the school surveys.[1]

Immediate purpose. The purpose of the present survey was to have the laboratory staff try out the new standardized

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[1] This survey was undertaken on invitation of the Des Moines Board of Education, with the personal coöperation of Prof. Alfred H. Smith, Supervisor of Music. The work of testing was divided between Mr. Henry M. Halverson and Miss Hazel M. Stanton, representing the Department of Psychology in the University of Iowa. Dr. Mabel Clare Williams and Dr. Esther Allen Gaw assisted in the study of the data. To all these the writer and the director of the Iowa Child Welfare Research Station herewith express thanks for hearty and very effective coöperation.

test material, "Measures of Musical Talent,"[1] under actual school conditions. In doing this we had several objects in view: to secure the data for the establishment of norms; to try out various alternative details of procedure; to study the reactions of pupils and teachers; to collect material as preliminary to a further study of exceptional talent; to evaluate the fitness of this test material; and, in so far as that is possible, to set a model for procedure with these measures, both in testing and in interpreting.

These are the purposes from the point of view of the laboratory staff. From the point of view of the city schools, the object was, of course, to obtain ratings of the musical talent of each child and communicate these appropriately to the authorities, and through them to the pupils.

Plan. Normally these tests would be made in the regular course of instruction, but, since the work was to be done by the laboratory staff, it could not be scattered throughout the year, but had to be given at one time in the form of a survey. This plan necessitated a certain amount of interruption of the school program which is not necessary in the regular use of the measures.

Two Grades. We limited ourselves to two grades, the fifth and the eighth; the fifth, because that is the earliest stage at which children can take a responsible part in a group test of this kind, and it is early enough for the stimulating of musical education; the eighth grade, because that is the sorting period in which it is most important to give guidance about special work in music in the high school, or about specialized musical interests for those who are entering the vocations.

Stages of the Survey. A complete survey of this kind involves three stages: first, the making of the five basic tests;

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[1]Columbia Records:

A7536	Measures of Musical Talent.	Sense of Pitch, No. 1A.
12 in.	Measures of Musical Talent.	Sense of Pitch, No. 1B.
A7537	Measures of Musical Talent.	Sense of Intensity, No. 2A.
12 in.	Measures of Musical Talent.	Sense of Intensity, No. 2B.
A7538	Measures of Musical Talent.	Sense of Time, No. 3A.
12 in.	Measures of Musical Talent.	Sense of Time, No. 3B.
A7539	Measures of Musical Talent.	Sense of Consonance, No. 4A.
12 in.	Measures of Musical Talent.	Sense of Consonance, No. 4B.
A7540	Measures of Musical Talent.	Tonal Memory, No. 5A.
12 in.	Measures of Musical Talent.	Tonal Memory, No. 5B.

second, the further intensive testing of cases selected on the basis of records in the basic tests, and of others presented by teachers or parents for examination for some sufficient reason; and third, the follow-up work, representing conferences with pupil and parent, and a record of the resulting progress. The present report pertains only to the first of these three stages, the use of these basic measures, for the reason that this survey was made in the spring of 1919, just before the schools closed, and the after-war conditions have prevented us from going into the field and following up the same children through the second and third stages. It is hoped that our staff may have an opportunity in the near future to treat these last two field problems adequately.

Reports Filed. Copies of the reports of all children examined are on file in the office of the city supervisor of music and in the hands of the principal of each school. In the present report we shall only give samples of records, since the main object of this report is to serve as a guide for future work of this kind, rather than as a report of results to the local constituency.*

The data from this Des Moines survey were used as the concrete material from which to compute *distribution of capacities, percentile rank tables,* and *norms in the form of ogives* in the above named manual and text-book. It will therefore not be necessary to repeat that material here, particularly as anyone who wishes to get an adequate acquaintance with the nature of the tests and their interpretation must consult these two sources, together with this report, as the three dovetail into a single presentation of the same subject from different angles without duplicating; that is, the text-book presents the psychological analysis of musical talents with interpretations of measurements and evaluations; the manual contains merely the specific directions for the use

* *References.* For the purpose of this report, it is necessary to assume that the reader has access to the *Manual of Instructions,* which is furnished free with the *Measures of Musical Talent* or may be obtained upon request from the Columbia Graphophone Company, New York; and to the author's "*Psychology of Musical Talent*" (Silver, Burdett & Co. 1919), in which the whole theory of the measurement of musical talent is explained and on which the tests are based.

of the phonograph records; and this report presents some data on the use of these tests in the school.

With such "division of labor" there falls to this report essentially the following: sample of record with explanation of items; a grouping scale with suggestions for its use; comparison of boys and girls; comparison of different schools; survey of several recommendations bearing on procedure.

SAMPLE OF REPORTS WITH EXPLANATIONS

Table I A and B is a sample of the final report as left on file. It represents the eighth grade pupils in the Elmwood School, and may be regarded as a fair sample of a natural set of records for a grade.

In this table the pupils are represented by numbers, the girls, I A, by odd and the boys, I B, by even numbers. Since material of a personal nature should not be made public, the names of the children, which in the original report occupy a space after the age, are omitted from this printed report. The age given is that of their nearest birthday.

The Percentile Rank. Then follow the records for the five measures, each expressed in terms of *percentile rank,* a common unit, namely, the rank in a normal community of the kind represented; in this case, eighth grade children. The scale is 1-100, in which 100 represents the best found, 1 the poorest found, and 50 the average. The norms for these are based upon the total number of records obtained in this survey. This rank is a very convenient means of conveying meaning of widely diverging types of measurements without any more technical concept than that of percent.

TABLE I A. *Elmwood School, Girls, 8th Grade*

Number	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
1	13	55	19	9	9	36	B	A	A	C	8 P.
3	13	86	67	84	84	25	D	B	C	D	13 V.
5	13	29	14	40	24	80	C	B	D	D	113 P.
7	14	19	19	70	18	20	E	D	C	C	38 P.
9	13	55	73	90	76	90	D	B	B	D	350 P. ?
11	14	23	3	55	58	22	B	B	B	C	102 P.
13	12	47	6	97	31	48	A	B	B		50 P.
15	13	78	91	60	94	71	C	D	D	D	10 P.
17	12	41	87	11	99	92	B	C	B	C	None
19	14	55	25	36	39	31	C	D	C	D	125 P.
21	12	59	25	11	39	67	A	A	A		188 P.
23	14	22	87	32	76	81	E	C	D	C	113 P.
25	12	68	67	93	97	67	C	C	C	C	14 P.V.
27	13	93	22	24	49	88	C	C	C	C	13 P.
29	13	78	56	70	84	98	B	A	B	D	38 P.
31	14	44	78	93	58	80	C	D	C	C	25 P.
33	13	95	56	60	90	64	C	C	C	C	25 P.
35	12	41	8	__	39	83	B	C	B	D	88 V. & P.
37	18	31	2	75	66	23	D	C	C	B	25 P.
39	14	33	46	87	58	76	C	B	A	C	400 V. & P.

TABLE I B. *Elmwood School, Boys, 8th Grade*

Number	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
2	14	10	14	40	24	4	D	E	E	B	None
4	13	7	6	32	13	__	C	C	E	B	None
6	15	41	14	40	18	38	D	C	D	B	None
8	13	41	61	84	66	59	D	C	C	B	75 P.
10	13	73	61	36	__	8	C	D	C	B	None
12	12	9	91	__	__	__	A	C	C		None
14	14	33	36	__	66	9	E	E	E	B	No Rec.
16	13	63	32	9	18	34	C	D	D	B	6 P.
18	12	59	67	40	49	76	A	C	B	D	10 V.
20	14	47	28	36	13	98	D	B	C	C	50 P.
22	12	86	93	98	99	91	B	B	C		100 Chi. P. & V.
24	13	44	61	93	66	89	C	D	C	B	No Rec.
26	11	35	83	50	13	14	B	C	B	B	No Rec.
28	13	63	56	28	66	84	E	E	D	B	None
30	13	47	25	36	__	27	C	C	D	D	18 P.
32	13	82	98	55	84	90	C	A	A	D	15 Cor. V. P.
34	11	86	51	80	76	91	C	C	C	D	25 Clar.
36	14	29	73	50	66	34	B	D	D	B	None
38	13	38	46	55	49	51	C	C	E	C	32 V.
40	13	25	51	45	13	9	D	E	C	B	5 P.

The Five "Measures." The sense of pitch measures the least perceptible difference in pitch. This is an index to the capacity for hearing musical values dependent upon pitch, and, therefore, indirectly for musical expression in pitch. The instructions were: "You will hear two tones which differ in pitch. You are to judge whether the second is higher or lower than the first. If the second is higher, record H; if lower, record L."

The sense of intensity measures the least perceptible difference in the intensity of the tone. This is an index to the natural capacity for hearing musical expression in terms of loudness of the tone. The instructions were: "You will hear two tones which differ in loudness, or strength. You are to judge whether the second is stronger or weaker than the first. If the second is stronger, record S; if the second is weaker, record W."

The sense of time is measured in terms of the least perceptible difference in two short time intervals. This is an index to the basic capacity for appreciating time, tempo, and rhythm in music. The instructions to the pupil were: "You will hear three clicks marking off two intervals of time. If the second interval (that is, the time between the second and third clicks) is longer than the first interval, record L; if it is shorter, record S."

The sense of consonance is measured in terms of the ability to judge the relative degree of consonance or dissonance in a graded series of consonance-dissonances. It is an index to the basic capacity for the appreciation of harmony and melody. The instructions were: "You will hear two combinations of two tones each; one combination is better or worse than the other in consonance (harmony). A good combination is one in which the two tones are smooth, and blend, tending to fuse together into one. A bad combination is just the opposite. If the second combination is better, record B; if worse, W."

Tonal memory was measured in terms of memory span for a sequence of unrelated tones. It is an index to the natural capacity for remembering, imaging, and imagining tones soon after hearing. The instructions were: "In each trial you will hear a series of tones played twice. In the second playing,

one note is changed. In listening count mentally; for example, 1, 2, in the first playing, and then likewise in the second playing, so that you may identify the one that was changed without error."

Teachers' Ratings. Then following the three marks, singing, brightness, and rhythm. These represent the judgment of the teacher rendered under the following instructions:

"Let the principal and the teachers, who know the children best, in the ward building, meet and classify the children as follows in each of the three items, brightness, singing, and rhythmic action:

Select the best 10% of the children listed and mark them A.
Select the poorest 10% and mark them E. Then,
Select the next best 20% and mark them B.
And the next poorest and mark them D.
This will leave 40% who get mark C, or an average.

Record the appropriate letter, A, B, C, D, or E, after each child's name in the respective columns.

Brightness: By brightness is meant the estimate of the natural ability to do the work that the school requires under favorable conditions. This does not mean school grades, because these are often low on account of lack of effort.

Singing: By singing we mean the ability to sing as shown in the public school music, taking everything that you can into account. Special features, such as the quality of the voice, skill in sight reading, and musical activities, may be mentioned under "remarks" if conspicuous.

Rhythmic Action: For rhythmic action base the general classification on your general observation of the child's ability to march, to skip, to dance, to take part in games requiring motor coördination, work in gymnastics, etc."

Enjoyment: In order to secure a record of children's judgments about their own enjoyment of music, the children were directed as follows:

"Put an X in front of the sentence which is true for you:

I do not enjoy music.
I like music fairly well.
I am very happy with my music.
Music is one of my greatest pleasures."

These responses were entered in the report as D, C, B, or A, the notation assigned to the respective propositions in the order given. Thus A represents the highest and D the lowest rating.

A study of these self-ratings shows that they do not correlate closely with the capacity measured or with the teacher's rating on the three items named. We should attach but little significance to these opinions in musical guidance. But the record may be worth having because it encourages us to ask why a child likes or dislikes or asserts that he likes or dislikes music. From this point of view the material is most stimulating and might start very profitable inquiries.

With this a number of other questions were included on opportunities for hearing music, character of music preferred, opportunities for musical performance, and questions bearing on heredity, but it does not seem worth while to burden the present report with that mass of material, although it is filed with the original report. The study of heredity which we intended to pursue here has been taken up on a larger scale by Miss Stanton in the systematic measurement of talents in famous musical families for the purpose of applying Mendelian principles to the problem.

Training: The last column states the number of private music lessons that the pupil has had, according to his own report, after a conference with his parents or teachers. The figures are given in terms of whole hour private lessons; hence, for lessons of twenty minute periods, three would count as one hour, and for half hour periods, two would count as one hour. The letters designate the instrument: V, violin; P, piano; Cor., cornet; Fl., flute, etc.

GROUPING

Classes recognized. For the purpose of ready reference in the selection and interpretation of returns, it is convenient to adopt a provisional grouping based entirely on the evidences in the objective record, leaving out of account personal knowledge of the child. For this purpose we adopted the following classification:

98%—100%	V. S.	Very Superior
91%— 97%	S.	Superior
76%— 90%	E.	Excellent
51%— 75%	G.	Good
26%— 50%	F.	Fair
1%— 25%	P.	Poor

Basis of Grouping: The percentage ratings in this table denote the final rank assigned by the examiner on the basis of the showing in the five objective measures. It is *not* the average of these. It takes no account of *case history, personal knowledge of the child, record of training, or rating on enjoyment.* The three teachers' ratings are regarded as only of secondary evidence and count only in case of doubt on the basis of the measures. The grouping is an interpretation of the net significance of the five measures as interrelated.

Incomplete records eliminated. Before making this grouping, all cases in which two or more of the five records of tests were missing were eliminated and designated as incomplete (I). The number thus eliminated amounted to 23% for the fifth grade and 5% for the eighth grade. These gaps in the records are due to various causes: *e. g.*, absence from the class at the time of a test; failure to respond satisfactorily to the test as noted by the experimenter; and internal evidence in the record of misunderstanding or other error. These records are not rejected but are merely set aside to be handled with reserve, without prejudice. It should always be made clear that the designation "I" is not itself any index to rank, although a record so classified may contain very definite information, favorable or unfavorable, as far as it goes. Since they are thrown out on the ground of incompleteness, and not on the ground of quality, the elimination does not affect the above grouping in percentages seriously, although there is actually a tendency of poor observers to leave "incomplete" records.

Objective basis. It is important to make this first grouping entirely on the basis of the objective record, quite independently of the personal knowledge of the pupil, or other systematic information gathered. This is important from the scientific point of view because it presents the objective rec-

ords as such to speak for themselves. It is often in the residuals, *i. e.*, the apparent discrepancies between objective records and expected results, that we make our most important findings. The reason for this becomes clearer when we bear in mind that the quantitative measures are specific and unbiased, whereas all other information is unanalyzed and usually loosely expressed, without either opportunity for exactness or realization of actual significance.

After this concept of the objective record has been formulated, great stress should be laid upon the accumulation of personal history, personal evaluation of the pupil's musical interests and achievements, outlets for musical expression, and countless other factors, often exceedingly intricate, which enter into the personal rating of talent and prospective achievement. The counsellor of the pupil will then have at command two profiles, as it were, of the talent, and can bring the two together for more effective analysis of the case than if personal bias or theory had entered into the objective record.

Danger of averaging. The first temptation is to find the average for each case as an objective basis in grouping; but that must always be discouraged. The making of this rating must be a personal judgment on the part of one who understands the meaning of each measure, and can balance factors so as to arrive at the best estimate of the extent to which the child should be encouraged in any music whatever. We should discourage every tendency to rank the pupils by averages, although, in the long run, there will be some agreement between the averages and the grouping adopted. The reason for this objection to the use of averages lies in the fact that we are dealing with different kinds of talents, as opposed to different quantities of talent in general. One person may rank 99% in pitch and 9% in time; another, 9% in pitch and 99% in time. Both are capable of becoming musical; one through tonal accomplishment; the other through rhythmical accomplishment; although each will have specific limitations. Our grouping should, therefore, be merely an index figure to be used only for the convenience in handling records. When advice is given, it should never be given merely in terms of this

label, but in terms of details shown in the analyzed objective record as interpreted in the light of supplementary data.

Exactness a restriction. This necessity of using personal judgment in the grouping, instead of resting on mathematical averages, makes the grouping difficult. It is well that it should be so, because that forces us to face the fact that we have here only a few selected measures; that these are very specific and do not represent talent as a whole; that they are measures of relatively different kinds of talent; that the value of each is dependent upon its relation to the other; and that some talents are more essential than others. Indeed, to the extent that we deal with exact facts, our conclusions must be restricted, for the conclusion should never hold more than is involved in the premise. We must recognize countless varieties of the possible inter-relations of talents and should be correspondingly cautious against artificial classifications and valuations.

Method of grouping. In forming the typical groups or norms here presented, Tables II to VII, we took all records for this survey and proceeded as follows:

We first marked all cases in which two or more test records were missing "I." By writing this letter in front of these records we set them aside as not available for the purpose of grouping. We then went through all of the remaining records by direct inspection, and assigned a tentative grouping as a rough approximation to the required distribution.

Procedure with the eighth grade may serve as an illustration. We found that in this preliminary grouping we had marked more than 4% V. S. To correct this we reviewed the cases marked V and culled by dropping case after case, in the order of doubtfulness, until, by this process of elimination the V. S.'s had been reduced to 3% of the total number of available records. The tentative V. S.'s thus dropped became certain S's. Computation showed that we still did not have enough S's to make 7%. We, therefore, reviewed the E's and selected from them, in the order of apparent excellence, enough to raise the number of S's to the required 7%. A similar procedure was followed for the E's. Since the distinction of those near the average is close and difficult to make we passed the next two groups and attacked the P group. Finding that we

had marked too many P's, we proceeded to select enough of the best of this group, in the order of excellence, to be raised to the B group in order to reduce the P group to the required 25%. This left 50% of all of the available records to be disposed of as G's and F's. We first reviewed the tentative grouping of these and checked all that were certain to be G's and those that were certain to be F's. This left a certain number of G's and F's in the margin of doubt. As they were now isolated and reduced to a small number it was a comparatively simple matter to cast off from this group, in the direction of

TABLE II. *VERY SUPERIOR* (V. S.) 98-100%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
85	A. H.	15	93	61	84	90	96	D	E	C	A	91 P.
10	A. H.	13	98	73	90	97	83	D	E	D	C	No record
24	A. H.	13	99	87	93	90	81	A	A	C	A	48 P.
16	Cas.	14	82	93	90	80	78	A	C	C	C	None
5	Cat.	14	90	87	75	--	99	B	C	B	A	No record
21	Cat.	14	90	61	93	76	83	D	C	A	A	40 P.
6	Cat.	12	90	83	93	76	89	C	C	E	C	20 P.
12	Cat.	13	97	91	90	76	91	D	C	C	C	30 P.
32	Cat.	15	98	93	93	97	83	C	A	B	D	No record
57	Cro.	13	99	67	84	76	89	A	B	A	A	30 P.
46	Cro.	14	68	97	99	84	98	B	C	B	B	No record
22	Elm.	12	86	93	98	99	91	B	B	C	C	100 P. and V.
5	Gre.	14	97	78	98	84	84	C	C	C	B	No record
28	Gre.	13	97	100	98	84	62	C	C	C	C	26 P.
32	Gre.	12	93	95	90	100	99	A	A	A	B	80 V., 20 P.
11	Han.	11	95	78	60	76	90	B	C	C	BA	No record
8	Han.	15	97	91	90	90	74	E	D	E	CD	No record
15	Hub.	13	95	67	98	97	99	C	A	A	A	3 terms P. & V.
11	Kir.	12	90	99	75	90	86	A	A	A	A	51 P.
2	Kir.	13	90	93	100	76	62	B	C	C	C	35 V.
22	Kir.	14	90	78	100	99	53	B	B	C	A	104 V.
20	McH.	13	86	97	90	97	96	C	B	B	B	? P.
51	Phil.	15	98	95	70	84	83	C	E	D	C	No record
2	Byr.	14	82	93	87	90	88	A	A	A	C	No record
13		12	93	78	87	99	95	B	B	C	B	25 P.

G or F, enough of this group, in the order of certainty, to equalize the two classes.

A Grouping "Scale." Tables II to VII constitute "types" of records, grouped in the manner just described. They are representative, in that we have taken the first twenty-five cases for each group in the order in which the records chance to come in our complete table of records for each group. For practical purposes in the immediate future this sample may serve for the evaluation of single records or groups of records not large enough to permit an independent grouping as in the present case. We may use this as a sample page of records somewhat in the manner that we use the handwriting scales at the present time, by assigning a given record to the group in which it finds its nearest match.

The Weighting. On the whole, we place most stress on the possession of the sense of pitch. Next to that comes the sense of time and the sense of intensity, in the order named. These three are basic, each representing a prominent attribute of music which may distinguish musical types. Thus we have the tone (pitch) musician, the rhythm (time) musician, and the expression (intensity) musician, if we may use these words in a somewhat forced meaning. The best is, of course, the possession of all three powers. Consonance is a complex, more or less related to pitch and, while memory is good for a musician, tenacious memory is not essential to certain kinds of musicianship.

The Secondary Criteria. The pupil marked A in brightness will make an entirely different kind of a musician from one marked E. Yet if the E pupil in brightness shows a high rank on other musical capacities he may still be regarded as decidedly musical, although the low general intelligence will make its unmistakable stamp on his musicianship. The same thing applies to the interpretation of rhythm and singing. The rating on rhythm is, however, of doubtful value except as a general index to the motor development of the child, because the concept can not be adequately defined in the instructions to those who rate, and it requires specialized training to observe motor rhythm in a penetrating way. While singing is a fairly definite concept, the grade on this achievement, more

than any other, impresses us with the difficulty of assigning general quantitative values. If a child is marked C in singing, what do we know about quality of voice, range of voice, register of voice, volume, training, inducements to sing, and many other factors which influence the teacher's estimate of achievement?

TABLE III. *SUPERIOR* (S.) 91-97%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
99	A. H.	14	55	73	93	84	95	A	C	A	A	75 P.
77	A. H.	15	81	61	87	99	67	B	A	C	A	20 Voi. 26 P.
95	A. H.	14	78	78	60	84	81	B	C	B	A	No record
111	A. H.	12	86	61	65	90	64	B	B	A	--	--
28	A. H.	15	97	67	45	99	95	B	B	B	A	115 V.
30	A. H.	15	95	97	60	94	53	D	C	D	C	26 P.
56	A. H.	13	82	91	93	66	56	C	A	A	A	23 Trombone
6	A. H.	14	93	78	80	18	67	A	B	B	A	8 V.
88	A. H.	12	97	56	70	90	71	B	C	C	A	No record
3	Bd.	13	90	78	75	87	78	B	--	--	A	45 P.
4	Bd.	13	97	61	99	62	81	C	--	--	C	10 P.
10	Bd.	13	86	95	97	92	45	C	--	--	A	No record
22	Bd.	15	100	56	93	92	74	--	--	--	--	--
34	Bd.	14	63	56	93	66	80	B	--	--	A	1 P.
19	Cas.	14	97	41	65	66	99	C	C	B	B	5 P .
6	Cas.	13	63	87	65	98	59	A	B	C	A	75 V.
9	Cat.	12	90	67	80	66	62	B	C	C	C	52 P.
25	Cat.	14	78	87	75	94	59	C	C	B	BC	78 P.
35	Cat.	13	82	51	98	66	86	B	C	E	B	64 P.
7	Cro.	15	93	98	50	84	88	C	B	B	A	16 P.
37	Cro.	12	98	93	60	49	67	B	B	B	B	26 P. V.
43	Cro.	14	97	93	98	31	96	B	B	B	A	No record
15	Elm.	13	78	91	60	94	71	C	D	D	A	10 P.
25	Elm.	12	68	67	93	97	67	C	C	C	B	14 P. V.
34	Elm.	11	86	51	80	76	91	C	C	C	A	25 Clar.

Danger of quantitative general ratings. We must persistently warn against the danger of assigning quantitative rating to undifferentiated factors. The beginner in the use of tests particularly needs to be impressed again and again with the

TABLE IV. *EXCELLENT* (E.) 76-90%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
35	A. H.	12	93	78	40	58	74	A	B	B	A	1 P.
57	A. H.	14	78	46	36	94	97	B	B	B	A	25 P.
59	A. H.	14	93	91	60	66	80	C	C	B	A	100 P.
89	A. H.	15	95	51	45	90	59	C	C	C	A	No record
115	A. H.	15	86	91	70	100	28	C	C	C	--	--
123	A. H.	14	82	61	32	76	69	B	C	C	A	45 P.
129	A. H.	15	73	83	60	66	56	D	E	C	C	No record
135	A. H.	15	59	46	87	94	83	B	B	B	A	10 P.
139	A. H.	14	78	32	65	84	94	C	C	B	A	No record
6	A. H.	14	68	41	70	94	86	B	B	A	A	96 P.
8	A. H.	16	86	91	98	49	45	B	B	A	A	No record
22	A. H.	14	68	95	80	24	69	C	A	B	C	No record
36	A. H.	13	51	73	87	84	74	B	B	A	C	No record
42	A. H.	14	73	83	65	90	71	C	A	C	B	No record P.
50	A. H.	15	90	78	6	66	71	A	B	A	C	No record
66	A. H.	14	82	67	93	13	76	A	C	B	C	No record
76	A. H.	14	31	97	90	84	51	A	E	D	C	No record
92	A. H.	14	100	25	80	66	78	A	C	C	B	110 V.
34	A. H.	12	82	32	84	66	59	C	C	D	A	--
60	A. H.	13	82	67	75	49	80	C	B	B	A	No record
72	A. H.	13	73	83	65	94	80	C	C	B	A	100 P.
98	A. H.	13	78	95	90	18	74	C	B	C	C	No record
9	Bd.	12	68	36	50	90	71	C			A	2 P.
15	Bd.	14	78	56	70	31	93	C			A	No record
19	Bd.	14	93	16	60	84	53	A			A	18 P.

responsibility of using all quantitative records merely as concrete cues which lead to a more penetrating analysis of the actual situation.

Same for All Grades. This grouping of cases taken from 8th grade records is equally applicable to all grades as a scale, since all records are in equivalent terms, *i. e.,* per cent rank for each grade.

Uses of This Grouping. The primary object in the grouping is to facilitate the handling of records. It may be used, first, to secure a general designation which may be conveyed

TABLE V. *GOOD* (G.) 51-75%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
1	A. H.	13	63	91	55	13	59	E	C	E	C	No record
9	A. H.	12	25	78	75	99	36	A	A	B	A	? P.
23	A. H.	13	98	36	17	76	48	A	B	A	A	28 P.
51	A. H.	13	41	56	50	94	71	B	B	C	C	72 P.
65	A. H.	13	68	73	84	49	88	C	C	C	A	36 P.
67	A. H.	12	55	--	36	84	84	B	C	C	A	? P.
71	A. H.	13	63	32	70	94	78	B	A	C	A	75 P.
81	A. H.	13	33	61	84	84	51	A	C	A	B	18 P.
87	A. H.	13	73	22	55	76	69	B	C	A	A	45 P.
1	A. H.	14	73	19	55	84	84	C	C	A	--	--
3	A. H.	15	41	10	32	99	88	E	C	C	B	25 P.
33	A. H.	15	73	32	--	76	84	C	C	C	B	1 year P.
35	A. H.	15	82	73	28	58	83	C	C	C	A	No record
41	A. H.	15	41	46	75	90	100	E	C	C	A	40 P.
45	A. H.	16	12	73	84	39	62	C	B	C	C	No record
61	A. H.	13	38	32	60	58	100	D	C	C	B	190 P.
69	A. H.	14	33	67	60	58	62	C	C	C	A	50 P.
71	A. H.	16	47	41	60	90	62	D	C	D	A	3 P.
79	A. H.	15	63	--	93	49	62	A	B	A	A	35 P.
83	A. H.	17	68	61	45	49	91	C	C	C	A	16 P.
93	A. H.	15	90	25	75	84	31	D	C	C	A	104 P.
99	A. H.	14	55	78	36	94	18	C	C	C	A	18 P.
103	A. H.	14	7	83	80	76	23	B	B	C	C	? P. V.
107	A. H.	14	68	32	36	94	64	E	C	D	A	32 V.
109	A. H.	13	44	83	20	58	90	D	E	C	A	7 P.

to those who are entitled to a report. Thus a record is Very Superior, Superior, Excellent, Good, Fair, Poor or Undetermined. The "Poor" should be regarded as "Undetermined" until after verification of the record by repeating the test, thus giving them every benefit of the doubt..

Where such a rating is given out in classifications and individual reports it should always be accompanied with the charge to take the analyzed ratings into account. Thus, our twenty-five cases of Very Superior are all different as is shown by the specific record. They may all be Very Superior, although each has its own character.

TABLE VI. *FAIR* (F.) 26-50%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
3	A. H.	14	25	22	80	66	38	E	C	E	A	No record
5	A. H.	14	59	61	24	76	31	B	A	B	A	5 P.
15	A. H.	14	55	36	45	66	67	B	D	E	A	10 P.
19	A. H.	14	25	36	84	66	78	E	D	C	B	No record
47	A. H.	14	73	19	--	94	34	E	D	D	A	27 P.
49	A. H.	13	73	8	24	13	71	D	D	E	C	No record
59	A. H.	13	47	51	70	49	25	B	B	A	A	No record
73	A. H.	15	78	67	32	13	59	C	C	C	A	? P.
77	A. H.	14	38	41	75	49	6	C	C	C	B	5 P.
79	A. H.	13	33	28	65	84	88	D	E	C	A	No record
83	A. H.	14	73	22	24	76	40	B	C	C	A	20 V.
85	A. H.	13	41	32	45	--	80	B	C	C	C	45 P.
91	A. H.	15	68	16	84	58	28	C	D	D	C	No record
101	A. H.	13	55	51	50	24	78	C	A	E	A	35 P.
9	A. H.	14	73	12	32	49	74	C	C	D	A	52 P.
11	A. H.	16	35	32	36	90	78	B	C	C	B	No record P.
13	A. H.	17	31	46	60	18	64	B	B	C	--	No record P.
15	A. H.	16	14	22	70	66	22	C	C	B	A	No record
23	A. H.	14	41	67	--	66	36	A	B	B	A	48 P.
25	A. H.	14	78	14	28	58	38	C	C	C	A	70 P.
31	A. H.	15	38	--	40	66	71	C	C	C	A	50 P.
53	A. H.	15	33	32	36	76	88	A	B	B	--	--
55	A. H.	15	55	51	50	66	27	D	B	B	A	6 P. 10 V.
65	A. H.	14	12	28	28	76	51	C	C	E	A	No record
67	A. H.	14	63	32	93	18	62	B	C	C	A	No record

The grouping is also convenient in the sorting of cases for follow-up work and further examination. The first three groups should be selected for special encouragement. All of these are good enough for professional or other highly intensive training in music, vocational or avocational, though many may not have studied music at all. They should be encouraged to consult good teachers and, if possible, to take further tests of capacity. The Good and Fair should be encouraged in music according to the internal evidence of the records. The Poor or Undetermined should be set aside for re-examination.

TABLE VII. *POOR (UNDETERMINED)* (P.) 1-25%

Number	School	Age	Pitch	Intensity	Time	Consonance	Memory	Brightness	Singing	Rhythm	Enjoyment	Hrs. Training
7	A. H.	13	31	12	--	13	9	C	B	B	A	? V.
11	A. H.	15	--	12	28	31	45	C	B	C	A	6 P.
13	A. H.	14	25	41	28	94	20	C	C	D	A	No record
17	A. H.	12	17	19	11	31	9	D	C	D	A	36 P.
21	A. H.	13	63	8	28	18	31	C	D	C	--	75 P.
25	A. H.	16	14	28	84	49	14	C	B	C	A	No record
27	A. H.	14	9	36	20	24	11	B	B	C	C	No record
29	A. H.	14	--	25	24	31	36	D	E	D	A	No record
31	A. H.	13	38	8	24	--	69	B	B	B	B	No record
37	A. H.	12	73	10	14	39	28	D	C	C	A	13 P.
39	A. H.	14	51	16	--	49	48	C	C	A	C	No record
41	A. H.	14	27	10	24	39	45	B	A	C	A	85 V. and P.
43	A. H.	14	7	28	65	31	84	E	C	D	--	No record
45	A. H.	14	51	28	20	24	43	D	B	C	C	No record
53	A. H.	13	63	16	24	13	43	B	B	B	C	No record
55	A. H.	15	--	12	32	9	12	B	C	B	A	No record
61	A. H.	15	--	36	36	76	17	D	D	E	A	10 P.
93	A. H.	12	47	14	20	66	23	D	E	D	C	No record
103	A. H.	13	29	3	14	13	9	A	C	B	C	No record
5	A. H.	14	12	--	20	58	36	E	C	C	--	No record
7	A. H.	--	12	46	--	76	2	C	C	C	--	--
17	A. H.	16	--	3	24	49	4	D	D	E	A	No record P. V.
19	A. H.	14	9	16	55	24	69	B	C	B	C	93 V.
21	A. H.	14	27	12	32	--	40	A	B	A	--	--
27	A. H.	15	20	1	36	66	56	C	C	C	C	No record
29	A. H.	14	33	41	--	39	25	C	C	C	A	8 P.

For the study of one year's record in a city school system, the examiners may group these records by themselves, but ordinarily, in examining a school or a small number of schools, the present grouping may be used in the same manner that we use handwriting scales.

What musical guidance shall be given for each group we are not yet in a position to state. We are, however, one big step in advance of practice in the past—we have some specific facts before us as a basis for advice.

KEY TO THE RECORDS

Pitch Key

	A	B	C	D	E	F	G	H	I	J
	30	23	17	12	8	½	1	2	3	5
1.	H	H	L	H	L	L	L	H	L	H
2.	H	L	H	H	H	H	L	L	H	H
3.	L	L	L	L	H	L	H	L	L	L
4.	H	L	L	L	L	L	L	H	H	H
5.	L	H	L	H	H	H	H	L	H	L
6.	L	H	H	L	H	H	L	H	H	L
7.	H	L	H	L	L	L	L	L	L	H
8.	H	L	L	H	H	L	L	L	H	L
9.	L	L	L	L	L	H	H	L	L	L
10.	L	H	L	H	H	H	L	H	L	H

KEYS, DISTRIBUTIONS, AND NORMS

Reference to the Manual. For the benefit of the casual reader the following samples of treatment are introduced from the *Manual* and *Text-book.* The illustrations are for the sense of pitch; the treatment of the other measures is analogous.

The phonograph records of pitch were made with tuning forks very accurately standardized. The instructions given by the examiner are:

"You will hear two tones which differ in pitch. You are to judge whether the second is higher or lower than the first. If the second is higher, record H; if lower, record L." (Manual p. 7)

The pitch disk contains one hundred trials, equally distributed over ten intervals from one-half vibration up to thirty vibrations in a geometric ratio of the second order. These one hundred trials may be repeated as often as the time permits in order to secure a good average. After the record has been completed it is corrected by the following key which shows the actual order in which the trials were made, the numbers at the top being the difference between the two tones in terms of vibrations. One vibration is equivalent to one fifty-fourth of a tone. The number of mistakes is then counted and the per cent of right answers is computed.

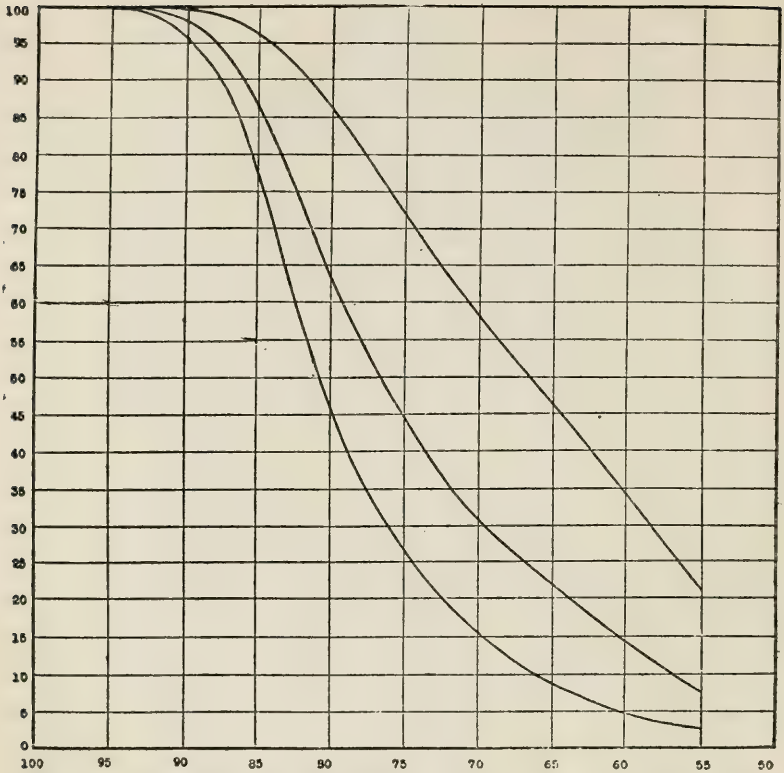


Fig. 1. NORMS FOR THE CONVERSION OF PER CENT RIGHT INTO RANK
The middle norm represents eighth grade children; the one above, fifth grade children; the one below, adults.

This per cent of right answers is then converted into percentile rank by reference to Table VIII in which the conversion figures are given for adults, eighth grade, and fifth grade. This table is represented graphically in Fig. 1, in which any per cent right for adults, eighth grade, and fifth grade may be converted into percentile rank by running vertically from the given per cent right indicated on the base line up to the ogive in question, then turning horizontally to the left where the scale shows the per cent right.

TABLE VIII. Rank for Pitch

% Right	Adult	8th Gr.	5th Gr.	% Right	Adult	8th Gr.	5th Gr.
100-94	100	100	100	74	23	41	69
93	99	100	100	73	21	38	66
92	99	100	100	72	19	35	63
91	98	99	100	71	17	33	61
90	96	98	100	70	15	31	59
89	94	97	100	69	13	29	56
88	91	95	99	68	12	27	53
87	87	93	99	67	11	25	51
86	81	90	98	66	10	23	49
85	76	86	97	65	9	22	47
84	70	82	95	64	8	20	44
83	63	78	93	63	7	19	42
82	56	73	91	62	6	17	40
81	50	68	89	61	5	16	37
80	45	63	87	60	5	14	35
79	40	59	84	59	4	13	32
78	36	55	81	58	4	12	29
77	32	51	78	57	3	10	26
76	29	47	75	56	3	9	23
75	26	44	72	55	3	7	21

In order to show distributions for various purposes it is convenient to present them, as in Fig. 2. The scale at the

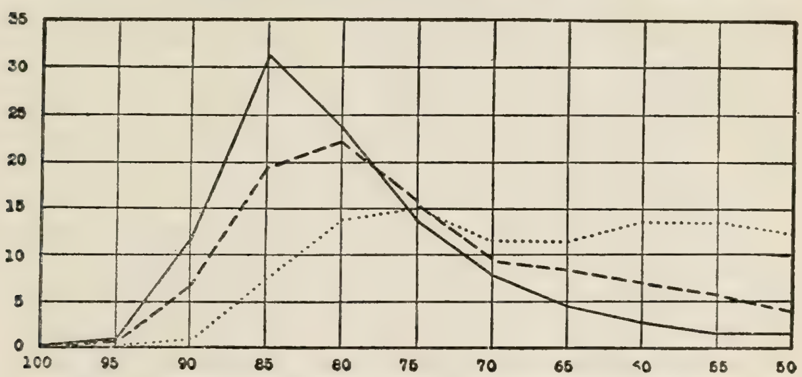


Fig. 2. DISTRIBUTION OF CAPACITIES IN THE SENSE OF PITCH
Solid line, adults; dashes, eighth grade children; dots, fifth grade children. The numbers at the bottom denote per cent right; the numbers at the left the percentage of cases for each level.

base runs from 50% right to 100% right. The cases are grouped symmetrically about the numbers given; *e. g.*, 85% right means from 82.5 to 87.4 inclusive. The scale at the left gives the per cent of cases that occur for each per cent right.

WHAT TO LOOK FOR IN THE MUSICAL TALENT RECORDS

It would take volumes to discuss adequately the material that the educator may draw from a survey of this kind in a city school. There is a mass of material for statistical treatment and for interpretation from the point of view of Psychology, Education, and Music. Much of this is discussed in the *"Psychology of Musical Talent."* I can here merely draw attention to the presence of this rich source of material and urge investigation by this method.

Discovery of Talent. The primary object of a talent survey is to locate talent. The investigator will be astonishingly gratified at the large number of items which constitute marked evidence of talent that has remained quite unrecognized and undeveloped. It is not claimed that these records reveal talent as a whole, but they do reveal specific talents which can easily be interpreted in terms of capacity for musical achievement. It is to the interest of the community, the school, and the home that this talent should be discovered early enough that it may be directed into opportunities for full development.

Even the identifying of known talent by the objective verifying and analysis of the talent is in a sense also discovery. The objective encouragement for intensive achievement which comes of such a rigid inventory becomes a profound stimulus to sustained effort. Many persons of superior talent are not taking their music seriously because they are not aware of their exceptional powers. To be told that you are proved to be in the best three per cent, for example, is not only encouragement but becomes also a challenge. It is from the higher groups that we must get our great musicians, and in a survey of this kind we have for the first time an objective and standardized method for the sorting of talents.

Explanation of Talent. "Musical" is a very loose term. These measures clearly characterize various kinds of talent; that is, they often show where the *fortes* as well as the *faults* lie. It is quite as important to know what kinds of talent the pupil possesses as to know their average magnitude. The teacher who may have worried about the rhythm of the pupil

exclaims, "There it is!" when she sees the very low rank in the sense of time of this pupil who sings well in true pitch, for which he has a high rank. "It is uncanny!" says another teacher when she sees how quickly and clearly the measures identify weak and strong points.

Let the thoughtful music teacher peruse a page of these records of her pupils and she will have not only explanations, but many challenges to meet the situations therein revealed. These challenges pertain on the one hand, to those cases in which a high talent may be the medium for a certain kind of musical achievement and, on the other hand, to those in which an impediment is of such a nature that it can not be removed but must be avoided. This recognition of difference in *kinds* of talent is the crying need of musical education today. One advantage of the objective record is that it will gradually bring the facts to the attention of the community whether the teacher is awake to their significance or not. Objective facts assert themselves.

Certifying Absence of Talent. One of the most cruel practices in musical education is the blind procedure of forcing the untalented to perform as if they were talented. The objective identification of specific impediments and the exact verification of these therefore becomes an important factor in the conservation of energies of the child. This is true both for the ascertaining of flat or general limitations and for the isolation of partial or specific limitations. Educators and parents are facing the time when they must stand in horror in the realization of what cruelties are imposed by unreasonable demands upon those who suffer from impediments. It is not a question of depriving anyone sparingly gifted of music but rather that of directing the existing powers into feasible channels of development.

The Magnitude of Individual Differences. A study of the range of distribution in the magnitude of capacities for each talent, as shown by the graphs in the *Manual of Instructions,* brings the situation into the concrete, showing that we are dealing here not with differences of double, triple, or quadruple merely, but with differences of a ten-fold, fifty-fold, and one hundred-fold magnitude in actual quantitative measure-

ment. When the teacher inspects the report and finds that in actual quantitative terms one pupil has ten, fifty or one hundred times the capacity of another in the same class, she is faced with a concrete problem which has never been brought to her attention so forcibly before. Her traditional effort to treat the two alike or to be satisfied with approximately equal returns from different pupils has been tolerated merely because, until we secured these quantitative measures, no one had realized that such enormous differences in musical gifts existed. There rests a moral obligation upon the school administration to use the means at hand for the discovery of the gravity of the actual situation.

Verification of Findings. The first impression of one who is not acquainted with evidence of this kind is to think that those who are low or irregular can be brought up. But with material in hand standardized rigidly in content and procedure, we are able to repeat the test as often as desired to show that, after one fair test has been given, the test may be repeated again and again only to be verified within the normal limits of fluctuation in observations of this kind. To make this all the more impressive pedagogically, those teachers who claim that they can create talent in the absence of talent should be forced to run a series of training exercises over months by their best method and then check up by actual measurement to find out the degree of their success, if any.

Hill and Valley. Superintendents are often anxious to find in these measures a means of rating efficiency of training, social advantages, and race differences. The general feeling prevails that the record of the children on the hill should, of course, be better than the record of talent of children in the valley where the poor and neglected live. Barring differences due to favorable or unfavorable conditions in the making of the test, we find that in both cases we are dealing with human nature which is quite evenly distributed regardless of social, economic, or educational status. The measures, therefore, have a peculiar mission in bringing to the attention of the authorities the presence of neglected talent in the valley, *i. e.*, poorer districts, and the danger of allowing this talent to go to waste by neglect.

Bright and Dull. Except for the factor of musical intelligence as a talent in itself, musical talents are relatively independent of the general brightness or dullness of the child. This is shown in a striking manner in the comparison of teachers' ratings on brightness with the grouping of the children on the basis of their measured talents. Here again in the problems of education, conservation, and social service, we must face some stern facts that should be taken into account.

Trained and Untrained. Parents and teachers will find food for thought in a study of the distribution of the privileges of musical education as indicated by private lessons in comparison with the measured talents. It is not enough to say that there is only a small indication to show that musical education goes to the musically talented. The teacher must be forced to collect the facts herself, verify them herself, keep them on her table, and ponder over them before she washes her hands of the responsibility of communicating the facts to parents and patrons, or the responsibility of taking them into account in organization of the music program. Those who have at heart community singing, social service, and the conservation of artistic energy will find in these figures indications of opportunities of profitable expenditure of effort.

Those Who Sing and Those Who Don't. The rating on singing gets an entirely new significance when interpreted in its relation to the measured capacities in talents. Very often children sing indifferently, badly, or do not sing at all without any excuse except that of maladjustment to the school, or some other fancied grievance. Others do not sing because they are not fitted to appreciate or perform the kind of music which is required of them. Still others make a bold effort, somewhat futile, in the face of limitations. The analyzed ratings should lead the teacher to a serious study of the extent to which the training in singing is developing the actually existing faculties.

Likes and Dislikes. A study of the children's own rating of themselves in regard to "enjoyment" of music in the light of observed performance and attitudes in music, in the light of the rank in the measures, and in the light of personal follow-up work with individual cases, soon exposes the danger of

attaching much significance to such "opinion" in deciding upon character and extent of training, or judging what music means to the child. If it were not equally true of adults we should be prone to say that such judgments are notoriously irresponsible even under the best of intentions.

Young and Old. The fact that musical talent is quite independent of age stands out clearly in the report. Gold is gold, and lead is lead, young or old. How fortunate it is to be able to discover the gold early, while there is still time to put it into the most profitable circulation!

Inheritance. We have experiments now in progress to show that musical talents are inherited, not as "musical ability" as a whole, but in the form of specific talents, such as those here measured, and that each specific talent or trait in music may be as independent of other musical traits as color of hair is independent of stature. To the educator who is interested in heredity the data in hand contain most interesting information about the relation of the children to their respective musical or unmusical families.

Awakening of Music Teachers. The administration will observe a striking reaction on the part of intelligent teachers to data of this kind. It stirs them to take a new point of view, to "question nature," to observe for themselves, to take an entirely new attitude toward this problem. They will first be baffled, but that is wholesome. To awaken an experimental or inquiring attitude toward the situation in music is a great step in advance.

SOME SUGGESTIONS ABOUT PROCEDURE

For the benefit of those who plan to introduce these measures, some suggestions on the basis of our experience may be in place.

Number of Trials. A fairly complete analysis of musical talent in an individual should contain two or three scores of items. It is our experience that, for a first preliminary dragnet to identify talent for hearing music, six tests seem desirable. These six include the present five "measures" and a measure of musical imagery, which requires no apparatus.

Directions for the measuring of imagery are contained in the Text-book (Chapter X). What supplementary data should be included, bearing on case history, musical heredity, musical associations, musical activities, etc., would depend upon local and personal interests of the time.

When and Where. The testing should always be part of the regular instruction in music and should be done during music periods. The test should not only be used for securing a record, but it should be referred to in successive periods in teaching the nature and significance of musical factors such as pitch, time, intensity, consonance, memory, and imagery.

If the tests are administered regularly in the fifth and the eighth grades all children will be surveyed twice, each time a period of adjustment in which this inventory should be of great value.

By Whom. There should be in each school system at least one, usually a supervisor, who is competent to direct the use of these tests. Rather than expect every teacher to do her own testing it would be well to trust a few to do this either as supervisors or by exchanging rooms in the same building. Frequent conferences will be needed for the discussion of findings and the organization of instruction and follow-up work. The conducting of the tests is a very simple matter, but their interpretation should be left to the few who can give some time to the study of the matter.

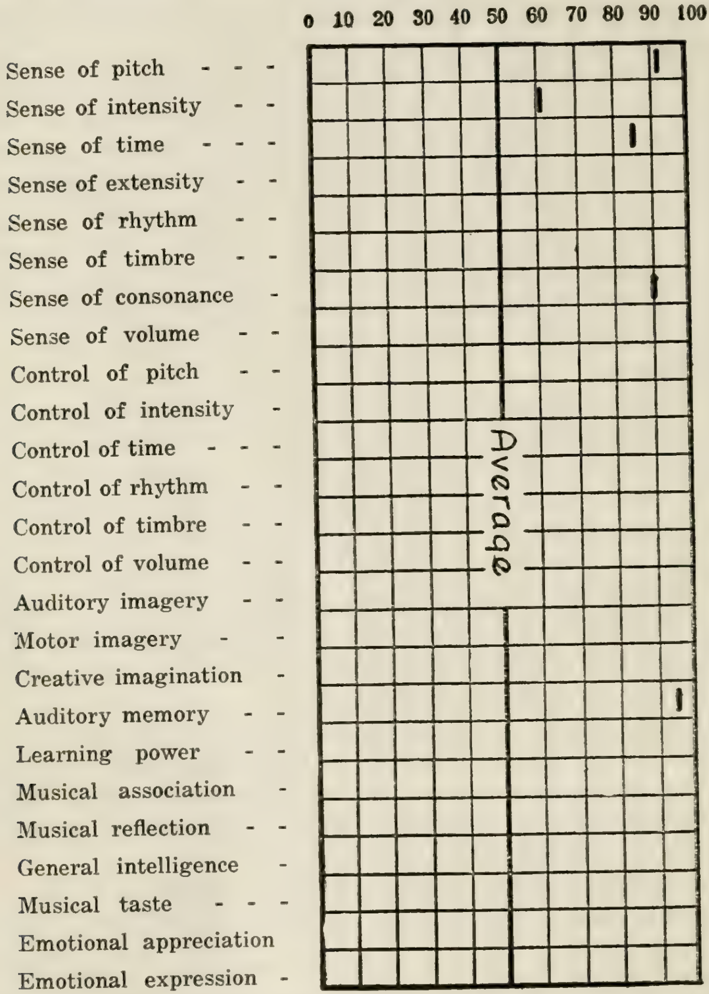
The Report. The data should be treated in the same manner that we treat records of achievement in other tests, such as arithmetic tests, spelling tests, or history tests; they should inform teacher, parent, and pupil of the existing situation, but they should not be made public.

Labor-Saving. Various devices may be used for labor-saving in the checking of records.* As routine work it should preferably be done right in the class-room by the pupil him-

* When large numbers of records are to be checked by the teacher, it will be found very convenient to take all of the records which have been made on the standard blank, make them into a pile and place on top of the pile a paper key made on the same blank. Then take a small nail and drive it through the whole pile of blanks in each of the blocks that have one of the two records, for instance, H in the H and L records for pitch. In this way all records are checked at the same time and all that is necessary is to count the mistakes.

Name --

Date --------------------*Examiner* --------------------



Observations, comments, and recommendations may be written on the back of this chart.

Fig. 3. MUSICAL TALENT CHART*

* In this case the record filled in is that of the first case in Table II.

self. The teacher will, of course, give each pupil his rank from the table in the *Manual of Instructions* on the basis of % right computed by the pupil with such help and scrutiny as may be necessary from the teacher. A blank chart on a card might well be mimeographed, or printed and supplied, so that the chart could be made out in duplicate, one for the teacher and one for the pupil. Fig. 3 shows a chart of this kind illustrating one record.

The Talent Chart. In order to visualize the records and present them in clear relief in relation to other talents it is recommended that the report of the children be given in the form of the talent chart herewith presented.*

Such a chart is very quickly made and it has several advantages over the mere numerical record. It impresses the fact that the talents measured are only a few out of all that must be taken into account. It brings before all concerned a comprehensive analysis of talent in such a way as to stimulate interest and activity in the effort of securing information in every available way on the points left blank. It holds before the pupil and the teacher bases for systematic observation and definite goals for achievement. A neat chart like this, of personal interest, is likely to be preserved and, therefore, to be brought to attention from time to time. It helps to broaden the pupil's conception of what is involved in music.

Follow-up Work. Unless followed up in school and at home the record is of small avail. The main consideration here is a live teacher. In case of doubt the test should be verified out of school hours. The teachers should use the various devices practiced by good music teachers in testing ranks with reference to actual capacity in performing. Talented children who have been neglected should be provided for at public school expense or through volunteer service of individuals or organ-

* When the charts are required in large quantities for the school system a zinc etching may be made from this page for use in printing. Where it is not thought desirable to do this, or where only a small quantity are needed, they may be obtained at cost from the Librarian of the University of Iowa. The record blank, page 5 of the Manual of Instructions and Interpretations, printed on both sides, may be obtained in the same manner.

izations. Particular pains should be taken to corral all talented children into the approved musical organization of the school.

Community and Home Tests. These tests should be conducted frequently at community centers. Home circles should be encouraged to conduct "scientific musical entertainments." One evening should be devoted to each test. A hostess might perform a gracious service, not only by entertaining neighbors and friends, because the taking of the tests is a most interesting contest, but also by discovering and thereby encouraging talent. The records are no more expensive than ordinary phonograph records, but a single set might well be allowed to circulate from family to family. Children may well be allowed to play with them and test one another as often as they like so long as they pay due respect to the key to the right answers.

Training Value. A strong case might well be made for the use of these measures for the sake of their training value. Few tests so completely engross the interest of the child as these do, and they furnish fresh illustrative material in the use of which the child acquires habits of accuracy and alertness in observation.

Ultimately the Attitude of a Physician. To the question as to what tests we can use in diagnosing delinquency in children sent to our psychological clinic the writer had to reply: "We use no set tests; we take the attitude of the physician and use the best means at our command for diagnosing the situation." Such will be the attitude of the music teacher and the musical examiner of the future. All "sets" of tests are at best fragmentary. But a standardized series of tests, like this, constitutes the simplest and most effective means of approach for general use. In whatever way these may be supplemented in the future, the principles here involved will remain basic.

FIRST SERIES NO. 39 DECEMBER 15, 1920

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 3

A PRELIMINARY STUDY IN CORRECTIVE SPEECH

by

SARA M. STINCHFIELD

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rates of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918

UNIVERSITY OF IOWA STUDIES IN CHILD WELFARE

PROFESSOR BIRD T. BALDWIN, PH. D., Editor

FROM THE IOWA CHILD WELFARE RESEARCH STATION

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UNIVERSITY EXTENSION BULLETINS BY MEMBERS OF RESEARCH STATION STAFF

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EDITOR'S FOREWORD

This study presents in a practical manner a brief analysis of some common speech defects among young children, with remedial suggestions in the form of special exercises. A more detailed account of consecutive work with two stutterers shows the significance of nutrition, orthodontic treatment, environment, mental attitude, intellectual status and systematic training.

No attempt has been made to give an anatomical description of the speech organs or an exhaustive treatment of the causes of speech defects. The selected references are limited to those bearing directly on the practical problems of corrective speech. This monograph is a portion of a dissertation presented by the writer in partial fulfillment of requirements for the degree of Master of Arts in child welfare.

Miss Stinchfield's work has been made possible through the cooperation of the divisions of the Research Station, the Department of Psychology, the Colleges of Medicine, Dentistry and Education, and the Department of Public Speaking.

BIRD T. BALDWIN

Office of the Director
Iowa Child Welfare Research Station
University of Iowa, Iowa City
September, 1920

A PRELIMINARY STUDY IN CORRECTIVE SPEECH

I. INTRODUCTION

The greatest progress in the acquiring and perfecting of a technique of speech is made, as a rule, by a child from the sixth month to the end of the third year of age. The quality of the child's environment and the training in these early years is of special significance to the investigator in speech development.

Young animals make noises as an instinctive response to environmental or internal stimuli and babies indulge in vocalization in the same way in which they reach and grasp for objects or ceaselessly move their eyes from place to place. Certain of these chance sounds resulting from accidental positions of the baby's vocal organs tend to be reproduced because of pleasant results of either approval and admiration of its efforts or satisfaction of its wants. Gradually these sounds become associated with the objects or activities which they represent. The sounds which shall become attached to an object depend on the language environment of the child. One child may come to associate the sound "bow wow" with a dog, another will say "doggie", and a third may say "woof woof", depending largely on which name tends to become fixed as a result of parental approval. Children frequently develop a language of their own, intelligible only to themselves or to their playmates. When this mode of speech has once become established, it takes careful training to develop more desirable speech habits.

Hand in hand with growth in control of the speech mechanism goes the development of normal speech so that between the fifth and sixth years, or by the time the child enters school, the early infantile habits of erroneous articulation should be outgrown. When "infantile speech" (baby talk), or indistinct, poorly articulated speech persists into the fifth year, there are underlying causes which may be organic and functional, of which the speech disturbance is only an indication. These causes may be classed as *organic*

if the disturbances of the speech mechanism are due to physical defects such as malformations of the palate or uvula, paralysis or atrophy of nerves and muscles; or *functional* if there is apparently no defect of structure but an interference with the normal action of the speech mechanism due to such causes as insufficient imagery, neurotic disturbances, or similar conditions. The distinction is an arbitrary one and is made only for purposes of further analysis and classification.

In order to obtain an empirical basis for corrective speech work, a preliminary study was made with one hundred thirteen children in the first six grades of the University Elementary School of the State University of Iowa, supplemented by observations on three hundred children in the public schools of Pittsburgh, Pennsylvania. The results make it possible to present at this time, a tentative classification of some of the common faulty speech conditions and causes of speech defects. As examples of the possibilities of the methods in remedial treatment, two type cases of stuttering from Iowa public schools are discussed in detail. A *scale* or method for speech examination is appended, together with a list of selected references.

II. OBSERVATIONS ON UNIVERSITY ELEMENTARY SCHOOL PUPILS

The procedure in the University Elementary School consisted in: (1) tests to discover individual speech disorders; (2) the immediate correction of minor defects through training; (3) educational, medical or orthodontic treatment, in coöperation with the teachers, University specialists, and the home.

Among the children examined there were forty-five cases where organic conditions were responsible for the defect. In fifteen additional cases the speech difficulty seemed to have a functional cause such as nervous instability. In ninety-three cases, this number including, of course, some of the cases of the first two classes, there was a functional disturbance evidenced by poor speech habits. Table I gives the distribution of the types of speech inaccuracies throughout the grades surveyed.

TABLE I

Distribution of Organic and Functional Speech Defects Among One Hundred Thirteen Elementary School Pupils

Grade	I. Organic	II. Functional A. Nervous Instability	II. Functional B. Incorrect Speech Habits	No. of Pupils in Grade
I	5	2	10	12
II	6	2	13	15
III	7	1	15	19
IV	11	3	23	25
V	6	2	10	16
VI	10	5	22	26
	45	15	93	113

The chief indications of inadequate speech development in the order of the frequency of their occurrence among these children were: tone monotony, poor enunciation and articulation, slurring (omission of sounds), marked mispronunciation, inaudibility, "sluggishness" (excessive slowness), nasality, lisping, faulty respiration, "cluttering" (excessive rapidity), stuttering (repetition of syllables), and "throaty" tones.

A group of twenty-five children most in need of corrective work were selected for special class training in speech with good results in the elimination of the more common faults.

III. A TENTATIVE CLASSIFICATION AND ANALYSIS OF DEFECTIVE SPEECH CONDITIONS AND CAUSES OF SPEECH DISORDERS

CLASSIFICATION

A. *Defective Control of Breath*

Speech conditions

Breathing on an inspiration instead of an expiration
"Breathy" tones
Spasmodic movements of diaphragm, glottis, and larynx

Causes

Adenoids
Diseases of naso-pharynx, nasal septum, sinus infection
Hypertrophied tonsils
Poor posture
General physical debility
Nervous conditions affecting the breathing mechanism

B. *Defective Articulation*

Condition: Mispronunciation

Causes

Malformations of oral cavity
Thickened tongue
Interdental spaces
Inaccurate tongue position
Paralysis of parts of peripheral speech mechanism
Defects of peripheral sensory mechanism, especially visual and auditory
Central defects in motor, sensory, perceptual or imaginal areas
Functional nervous disturbances
Wrong habits of speech
Defective mentality

Condition: Echolalia

Causes

Defective mentality
Infantile speech habits

Condition: "Sluggishness"

Causes

Physical debility
Malnutrition
Adenoids
Hypertrophied tonsils
Defective mentality
Nervous disorders

Condition: "Cluttering"

Causes

Nervous disorders and psychical condition
Incorrect speech habits

Condition: Stuttering and stammering

Causes

General physical debility
Shallow breathing
Nervous disorders
Psychotic condition

C. *Defective Vocalization*

Condition: Complete absence of speech or absence of special tones

Causes

Paralysis of parts of peripheral speech mechanism—lips, tongue, larynx, palate, or vocal cords.

Lesions in central areas—motor, imaginal, association—or in projection fibres, or in lower nuclei

Deafness

Functional nervous disorders

Psychotic condition

Condition: Nasality

Causes

Cleft palate

Hair lip

Adenoids

Deflected septum

Laryngeal or palatal paralysis

Persistence of wrong habits of speech

Lack of use of nasal passages

Condition: Monotony

Causes

Cleft palate

Adenoids

Deflected septum

Infected tissues

Peripheral or central defects in nervous mechanism

Psychotic conditions

Condition: Hoarseness, harshness

Causes

Defect of vocal cord

Local inflammation

Condition: "Throatiness"

Causes

Elongated uvula

Thick tongue

Hypertrophied tonsils

Wrong habits of speech

Condition: Non-sibilant or high pitched voice

Causes

Shallow breathing

Defect of vocal cord

Thymus and thyroid disease

Local inflammation

ANALYSIS OF DEFECTIVE SPEECH CONDITIONS AND CAUSES

A. *Defective Control of Breath*

One of the most important factors in defective speech is poor control of breath during speech. This lack of control is both a symptom of disturbed speech functioning and a cause of further speech disorders. Under normal conditions the motor response to the speech impulse is immediate and accurate. Through habit formation the child gradually gains control of the muscles of tongue, lips, uvula, and larynx until the process of phonation has become automatic and effortless. Speech disorders are almost always associated with disturbances in the normal smooth working of this process. A common cause of faulty respiration is the obstruction of the respiratory passages by adenoids, hypertrophied tonsils and thyroid glands or inflamed tissues. Other contributory causes are: poor posture, general physical debility, and functional nervous conditions affecting normal breathing. If automatic breathing is thus interrupted the child speaks in a jerky manner, attempts phonation on an inspiration instead of an expiration, or produces gasping or "breathy" tones, in which the breathing sounds are distinctly audible. In extreme cases these conditions are accompanied by spasms of the diaphragm, rapid pulse, throbbing arteries and great mental excitement, sometimes with fear. The development of breath control is therefore regarded by most authorities in the field of speech and song as the first point of attack for the correction of vocal defects.

B. *Defective Articulation*

Mispronunciation

Under the head of mispronunciation may be classed a variety of symptoms due to a number of causes. The common characteristic of these cases is the fact that the word as articulated does not correspond to the printed word or to the correct sound. Mere inability to read fluently can scarcely be classed as a speech difficulty. There are, nevertheless, cases of children who habitually speak with ease but hesitate and become confused when confronted with the printed page. Another more serious condition is lisping, which is defined by the majority of authorities in the field of speech as the substitution of other sounds for *s, z, sh,* and *zh* sounds as they

occur in various combinations. Frequently the fullness and distinctness of normal enunciation gives place to a blurred effect. The child may be able to produce the individual sounds of all consonants accurately, but slurs and alters them when they occur in combinations. Under the term ''blurred enunciation'' are classified the production of indistinct initial, middle or final letters, inaccurate prefixes, diphthongs and consonant combinations, and the dropping of syllables. Another class of mispronunciations includes certain aphasic conditions in which there is distortion of words, transposition of syllables or phrases, or utterance of meaningless combinations of words and sounds. The babbling and lalling of infants and of adult idiots are similar meaningless combinations of sounds, due, however, to different causes.

The causes of mispronunciation are both organic and functional; in fact, so closely are causes related in most cases that it is fruitless to attempt to assign to each its share in producing the defect. A common cause of mispronunciation is the poor shape and size of the oral cavity, resulting from malocclusion, high palate, inter-dental spaces, thickened tongue, or incorrect placing of tongue with distortion of the space through which the air must pass for correct articulation. Lisping is especially apt to occur under these conditions. Mispronunciation will also occur if there is paralysis of the muscles and nerves governing the peripheral speech mechanism. For example, a paralysis of the facial nerve on one side will make it impossible for both sides of the mouth to act coördinately in shaping certain letters. Any deficiency in the peripheral sensory mechanism will also be reflected in faulty pronunciation, since accurate perception is the basis for a correct concept. A child who is myopic mispronounces letters he does not clearly see; a child who hears only certain tones mispronounces words he has only partially heard. In both cases a false concept is formed as a basis for future mispronunciation. Correction of these defects of the sense organs is possible. This is not true, however, with another class of causes in which there are central defects in the motor, sensory, perceptual or imaginal areas that render impossible the correct apprehension of a word and the execution of the vocal act. The same defect is produced by functional nervous disturbances of these centers. Incorrect speech habits, sometimes as a result of imitation, are another frequent source of mispronunciation. A combination of organic

disabilities and incapacity for rapid formation of correct habits would account in large measure for the mispronunciation and other types of speech defect commonly observed in mental deficiency.

The speech of the mentally deficient child varies from an inability to pronounce numerous consonants, to unintelligible speech of a babbling or of a lalling type. There is frequently a misapplication of words, inability to recall the appropriate word, imperfect arrangement of sentences or slurred, hesitating and indistinct speech. Speech usually develops late in mental defectives. Idiots commonly have no speech at all. Imbeciles are able to understand and speak short sentences, but never acquire a large vocabulary or perfect articulation. Morons show fewer imperfections of articulation and a more extensive vocabulary, but are usually incapable of constructing or understanding a complicated sentence. It is recognized by authorities on feeble-mindedness that there is a distinct relationship between the capacity for speech and the degree of mental defect. In fact, an early classification of mental defectives used the degree of speech development as a criterion for the amount of defect, those without speech being classed as idiots. This is unwise, however, as the absence of speech may be due to some very different cause. In view of our modern knowledge of aphasia and similar disorders, it would be manifestly incorrect to class as idiots all children in whom speech is absent.

Echolalia

Echolalia is a peculiar form of verbal response seen in the lower grades of mental defect. In can be classed as a speech defect only because the subject does utter words. It has been explained as a symptom of an organic condition in which the lower nervous centers are abnormally permeable to the nervous discharge with the result that the incoming excitation is immediately transformed into an outgoing impulse without traversing the appropriate higher speech areas. Consequently, the child merely echoes words or phrases with no understanding of their meaning. Partial echolalia may appear and persist as an infantile speech habit in children who are not abnormal.

"Sluggishness"

The normal speech of children is fairly energetic and smooth.

Excessively slow and hesitant speech is usually associated with physical disabilities. The speech of many feeble-minded children, especially cretins, is frequently sluggish because of their general lack of energy and vitality, resulting in slow reactions. In normal children such sluggishness may be due to exhaustion after illness, anaemia, or interference with proper respiration, because of the presence of adenoids and hypertrophied tonsils. Sluggish speech is also often manifest in nervous disorders or psychotic conditions such as dementia praecox, depressed states and the hysterias.

''Cluttering''

In contrast to ''sluggishness'' is the condition known as ''cluttering,'' when there is excessive rapidity of utterance. The ''clutterer'' is often a child of superior mentality whose thoughts run ahead of his ability to express them, with resulting faulty articulation because of the inability of the motor mechanism to keep pace with the speech impulse. In highly neurotic children who show this speech condition, the over-productiveness is associated with respiratory difficulties, defects of vocalization such as shrillness, monotony, etc., and intense mental excitement. The treatment for these defects must be directed toward improving the general nervous condition of the child and training him in good speech habits.

Stuttering

Stuttering is difficult, unrhythmical speech characterized by spasmodic contractions of the entire oral mechanism and incoördination of the respiratory, laryngeal, and oral muscles. The nerve centers are often so innervated that the individual is unable to phonate either momentarily or for a longer period. This condition may persist for several weeks. The accumulated energy which is not directed into the appropriate centers in the oral mechanism overflows into centers controlling the muscles of eyes, face, chest and arms.

Stuttering seems to be dependent on a congenital weakness of the speech organs; some authorities believe that it may recur in several individuals in successive generations of the same family. A great many very young normal children show slight signs of stuttering, however, when they have not yet acquired sufficient control of the speech process to make it automatic. This is especially the case in children of neurotic and emotionally unstable type. Indeed there

is an intimate connection between stuttering and strong emotion. Adults who have been cured of stuttering will suffer a relapse under great excitement and children will often manifest the first signs after a shock or fright. Any great physical strain, a severe illness, chorea, or pubescent changes will precipitate an attack in neurotic subjects who are predisposed to the disorder.

In addition to being handicapped by nervous instability, or perhaps because of this defect, the stutterer generally suffers from a morbid mental state. He is typically introspective, hypersensitive, apprehensive, and seclusive. His speech disturbance makes him socially ill-adjusted and his unsocial tendencies serve to isolate him still further. Before speech and respiration exercises can be expected to cause much improvement, the stutterer's whole mental attitude must be changed, his attention directed to external interests, and his social personality developed. General physical upbuilding is of fundamental importance in the correction of stuttering, as of all speech defects of nervous origin, and usually brings an immediate improvement in the condition.

C. Defective Vocalization

Under the head of defects of vocalization are classed complete absence of speech and certain departures from the quality of the normal voice.

Absence of power to speak results in some cases from lesions, disease, or congenital defects producing paralysis of the parts of the peripheral speech mechanism—lips, tongue, larynx, and palate. A paralysis of a certain part produces a characteristic change in the vocal quality, due to the change in the aperture through which the air must pass, or to non-functioning of some of the vocal cords. Complete absence of speech results also from lesions in the central areas—motor, imaginal, associational—or in their projection fibres. The phenomena of aphasia resulting from such lesions have been too frequently described to bear repetition here. Absence of speech also occurs as a result of functional involvement of any part of these centers or of their pathways.

Mutism is frequently consequent upon congenital or acquired deafness, since the child is not stimulated to imitate sounds which the hearing child experiences. For the deaf child special devices must be used in order that visual, tactual, and kinaesthatic imagery

may serve as guides and awaken speech in a child born deaf or preserve it from deterioration in one who has become deaf.

Refusal to speak is a psychopathic manifestation frequently mistaken for real inability to vocalize.

A number of other changes in quality, not due primarily to paralysis, are discussed below.

Nasality is frequently due to changes in the air passages resulting from cleft palate or hair lip. Owing to the absence or shortness of the velum, the child is unable to shut off the opening into the naso-pharynx during the emission of oral consonants, with a resulting unpleasant quality in these tones. Nasality may also be due to deflection of the nasal septum which interferes with the reinforcement of tone by the resonance chambers of the head. So, also, adenoid growths blocking the naso-pharynx interfere with the nasal resonance.

Nasality also results from certain forms of laryngeal and palatal paralysis. Frequently it is merely the result of habitual constriction of the throat and posterior nasal passages.

Monotony. Absence of proper inflection and of pitch changes characteristic of the normal voice frequently occurs as a result of cleft palate, adenoids, deflected septum, or obstruction of the passages by diseased tissue. Peripheral or central defects in the nervous mechanism are often responsible for the monotonous tones frequently observed in the speech of persons suffering from nervous and mental diseases.

Hoarseness; harshness. Chronic pharyngitis, or "clergyman's sore throat", is one of the most common types of huskiness or hoarseness. The muscles of the pharynx become constricted in movement, inflamed and uncomfortable, modifying the vocal resonance. This may be due to extreme fatigue, long continued use of the voice under abnormal conditions, or to misuse of the voice. Other defects of the vocal cords may be responsible. Recurrent or persistent hoarseness is an indication of abnormal conditions necessitating medical examination.

"Throatiness." A peculiar quality of the voice known as "throatiness" sometimes results from an elongated or hypertrophied uvula, which interferes with the lingual sounds. Hypertrophied tonsils or a thickened tongue will partly fill the resonance chamber, altering the timbre of the voice to produce this effect. A

habit of elevating the posterior portion of the tongue and pressing the soft palate against the posterior wall of the pharynx is another frequent cause of this unpleasant vocal quality.

Non-sibilant voice. When no deformity or physical defect exists in the speech resonance chambers, a non-sibilant or high-pitched voice of unpleasing quality is frequently due to shallow breathing and respiratory disturbances. The attempt to speak with only residual air in the lungs, rather than upon a fresh inspiration, will produce such speech. It is also found that affections of the thymus and thyroid glands are associated with this type of speech. Atrophy, defect, or local inflammation of the vocal cords is capable of producing high pitched tones, lacking in richness and without the overtones which are found in the voice of lower pitch.

It appears from this analysis that some speech defects are due to organic conditions such as paralysis, which are not subject to correction. For children with other organic defects such as malformation and obstruction in the air passages, the prognosis is favorable, provided these conditions are corrected. Children suffering from functional conditions which may be classed as minor speech inaccuracies due to incorrect habits, will respond to treatment and training in a most satisfactory manner. A program for successful work in the correction of speech defects must include: (1) correction of physical defects and general physical upbuilding; (2) establishment of proper mental attitude; (3) speech training. As type studies of this mode of procedure there follow two cases.

IV. A REPORT ON TWO TYPE CASES

Type Case A

In September, 1918, a ten year old boy who had been a stutterer since the age of three years, was brought to the Iowa Child Welfare Research Station for examination. As he was found to be in need of medical treatment, he was kept in his home in a small town in Iowa for this purpose during four months, and then brought back to Iowa City for six months' observation and training.

By means of numerous interviews, letters, and conversations with the boy himself, the staff of the Station gradually gained an insight into the child's background and personality.

The boy had been physically feeble from infancy. While the

family history showed no grave abnormalities, it did reveal a neuropathic strain. In a maternal uncle and in the boy's only sister, a girl nineteen months his senior, appeared the same tendency to stuttering that handicapped the boy. The boy's mother, though an intelligent woman, who had taught school for a number of years before her marriage, was of a nervous and introspective type. John's habitual emotional tone was low; he did not care to play with other boys of his age with whom he could not compete on account of his lack of strength, and he was extremely sensitive to criticism and very much aware of his disabilities.

Anthropometric measurements showed that John did not vary greatly from the average for his age; the height, weight and breathing capacity were slightly below the normal. The boy appeared malnourished and was very easily fatigued.

Although the tonsils and adenoids had been removed (and circumcision performed after the boy's preliminary examination at the Station), it appeared from the report of the University Hospital that his general condition was still poor. He showed the effects of rickets in infancy. At the time of examination, there was present a latent tetany and chronic indigestion, which seemed to be connected partly with his habits of eating large amounts of a poorly balanced diet, and partly with his poor mastication as a result of dental deformities. The University dental clinic found that he suffered from malocclusion and marked protrusion of the upper teeth, both upper and lower arches being narrower than is normally the case.

This dental condition contributed to his speech defect. Nasal obstruction had been removed, but the boy still had poor control of the breathing apparatus; there was marked spasmophilia of the respiratory and facial muscles during speech, with some involvement of the frontal muscles and protrusion of the eyeball. His specific stuttering difficulties were with the production of the vowels *a, o, u,* in initial positions and with certain consonants at the beginning of words; stuttering took place upon practically every consonant when used as an initial letter. During protracted stuttering the hypertonicity of the speech mechanism communicated itself to the muscles of the arms, head, and trunk.

The speech defect was associated with much forgetfulness and frequent mental confusion, resulting in a blocking of the speech

centers and peripheral speech mechanism under excitement. Under favorable circumstances, a mental rating was obtained which showed John to be of average intelligence with a Terman I. Q. of 103. Other psychological tests, undertaken because of their possible bearing on the speech problem, revealed normal audition but an exceedingly poor functioning of imagery.

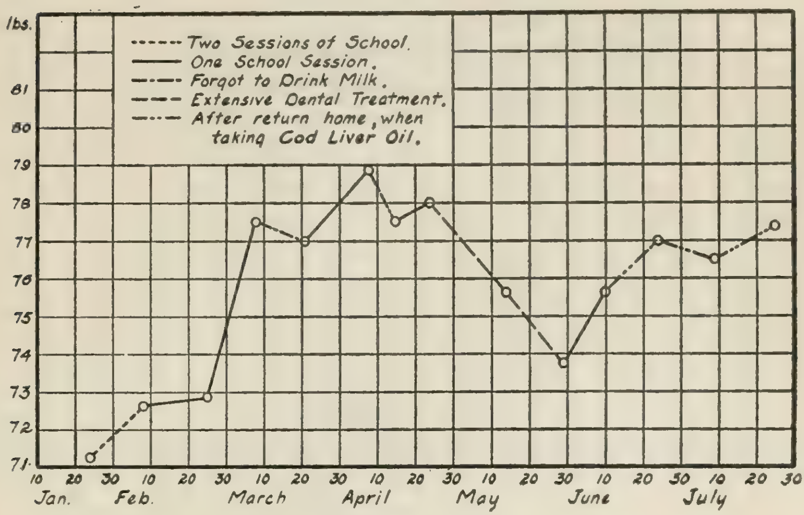
It seemed evident that the first step in overcoming the speech difficulty was to improve the boy's general condition and provide a better environment. Arrangements were accordingly made to have him board in Iowa City in a family where there were two active boys whose companionship would prove beneficial. A schedule was made for each hour of the day in order that the boy might acquire better habits of living. Diet was carefully regulated, proper amount of rest insured, and healthful outdoor exercise encouraged. A record of weight was kept and the appended weight curve plotted.

Orthodontic work was undertaken at the University Clinic to correct the malocclusion. John was not allowed to attend afternoon school but rested for a period after dinner and was then given special speech training. This included tongue and mouth gymnastics, breathing exercises, harmonic gymnastics, drill on difficult sounds, together with general work to improve speech melody and inflection and to increase range and volume of tone. A special effort was made through dramatization, playing store and using the telephone, to establish self-confidence. Phonographic records were made of the boy's speech twice a month so that the gradual elimination of stuttering could be studied.

As part of John's difficulty in speech seemed to be connected with his introverted habit of mind, an attempt was made to overcome his morbid tendencies by having him come to the laboratory regularly to talk over his problems and acquire a more wholesome attitude toward life.

It was understood from the beginning that the complete rehabilitation of this boy would require a very long period of close supervision in a controlled environment. Nevertheless, the corrective measures undertaken for even these few months, produced a measureable result as is shown by the appended curves and photographs of his progress in overcoming speech difficulties, increasing his weight, and obtaining more normal occlusion.

The accompanying weight curve shows in an interesting way the



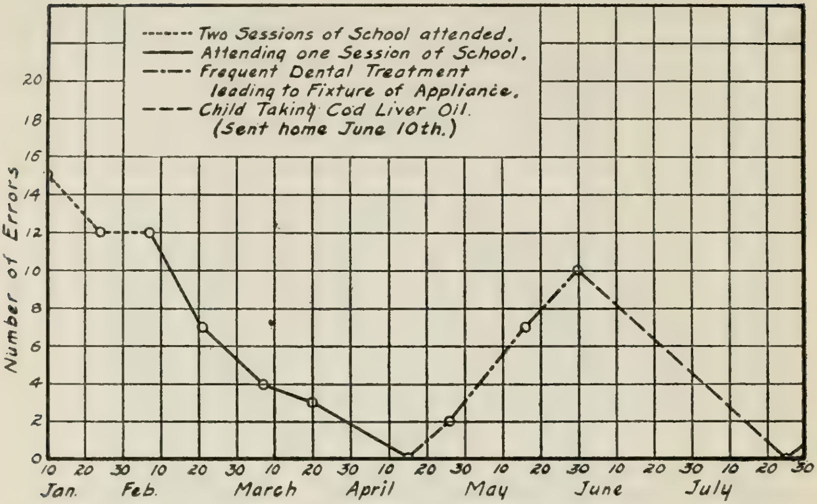
Weight-curve—John

effect of the prevention of excessive fatigue, of special additions to diet, of dietary disturbances, and of irritability due to dental treatment—each such disturbance resulting in a loss of weight. As a result of improved assimilation of food consequent upon better living conditions and dental care, growth in weight was considerably stimulated.

The record of phonographic speech errors shows similar fluctuations. In general, there was a reduction of stuttering errors from fifteen in the first record to none in the record taken at the end of four months. When the dental appliance was first placed in the mouth, the errors again increased, but they were practically eliminated after six months' treatment.

The great improvement in the shape of the dental arches is shown by the appended photographs of the casts made of John's teeth before and after treatment, including a period of ten months.

In view of his generally improved condition, it was thought not inadvisable for him to return home provided occasional visits were made for further orthodontic work and re-examination at the Child Welfare Station. Up to the present time there appears to have



Speech-errors—John

been continued gain in weight, generally improved speech (though occasional relapses into bad speech habits have occurred), and a real improvement in social reactions.

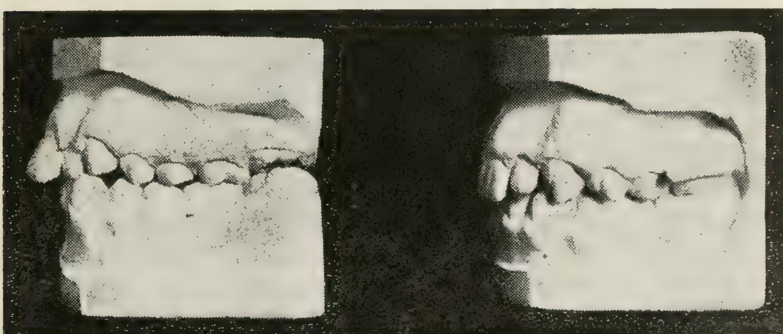
WEIGHT OF JOHN

Jan. 24, 1919	71¼ lbs.
Feb. 8th	72⅝
Feb. 25th	72⅞
March 8th	77½
March 21st	77
April 8th	77⅞
April 15th	77½
April 24th	78
May 14th	75⅝
May 29th	73¾
June 10th	75⅝
June 24th	77
July 9th	76½
July 25th	77⅜

Phonographic Speech Record of John
January 10th to August 8th, 1919

	ERRORS
January 10th	15
January 24th	12
February 7th	12
February 21st	7
March 7th	4
March 20th	3
April 15th	0
April 26th	2
May 16th	7
May 30th	10
July 25th	0
August 8th	2

The picture shown below in the accompanying cut represents the degree of malocclusion existing before John began orthodontic treatment at the Dental Infirmary in May, 1919. The picture at



the right shows the improved occlusion ten months later (March, 1920), the following results being evident: *first,* the widening of the mouth space (1/8 inch in the canine region and approximately 3/8 inch in the premolar region); *second,* the correction of the inward slant of the premolars to normal position; *third,* the improved position of the incisors of both upper and lower arches; *fourth,* the development of the premaxillary bone. Since these corrections have been made, good mastication of food has been secured, proper breathing habits are being established, and physical growth has been accelerated.

Type Case B

In January, 1918, a member of the psychological department of the University on a trip to a nearby town examined a girl of twelve years, who was suffering from stuttering. He reported her to be of about average intelligence, but very nervous. In October, 1918, she was brought to the Research Station for further examination.

The family history as reported by the parents revealed a tendency to "nervousness" in the mother's family and another case of stuttering—the mother's brother. The girl herself had begun stuttering upon entering school and at the beginning of each school year had shown for a time a slight speech disturbance. During the fall of 1918, this recurring attack had become so severe as to impress the parents with the necessity of seeking help from the Research Station.

The girl had had no very severe diseases and appeared to be well developed, though slightly underweight. The physical examination at the University Hospital revealed nothing of consequence except enlarged tonsils. Her posture was, however, poor, her chest was noticeably flat, and her behavior showed signs of excessive nervousness, being characterized by jerky, awkward movements.

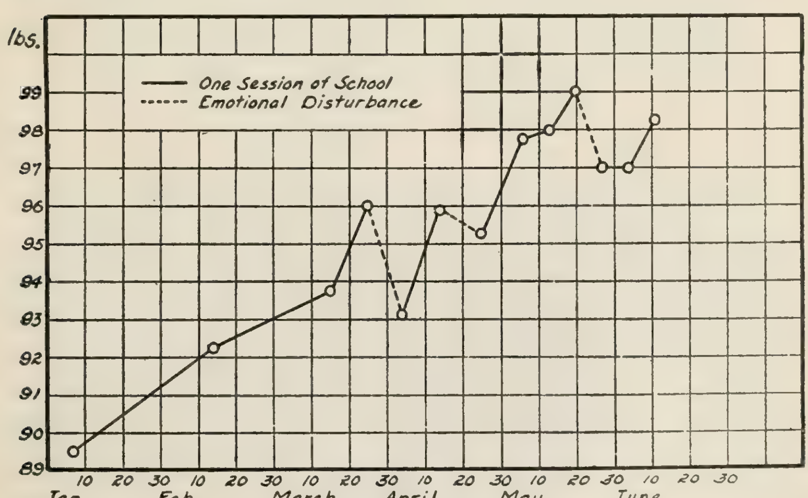
The child was obviously in the prepubescent period, though the parents did not seem to be aware of this fact. They had, however, consulted the family physician in regard to this nervousness and had been specially warned against over-stimulation.

Alice's emotional condition was apparent in her facial expression, which indicated sulkiness, stubbornness, and pouting. Further acquaintance showed her to be a highly strung, over-stimulated girl of nervous temperament, easily excited, lacking in control and decidedly willful.

The mental examination at the Research Station confirmed the earlier diagnosis of average intelligence. With a chronological age of thirteen years, seven months, and a Terman mental age of fourteen years, eight months, her I. Q. was 108 No defects in imagery were discovered, although there apparently was a deficiency of this sort, since Alice was unable to reproduce short stories or to recount incidents from her daily life and showed, moreover, an intense dislike for any exercise requiring reproduction from imagination. She had also all the inhibitions and dread of failure common to habitual stutterers.

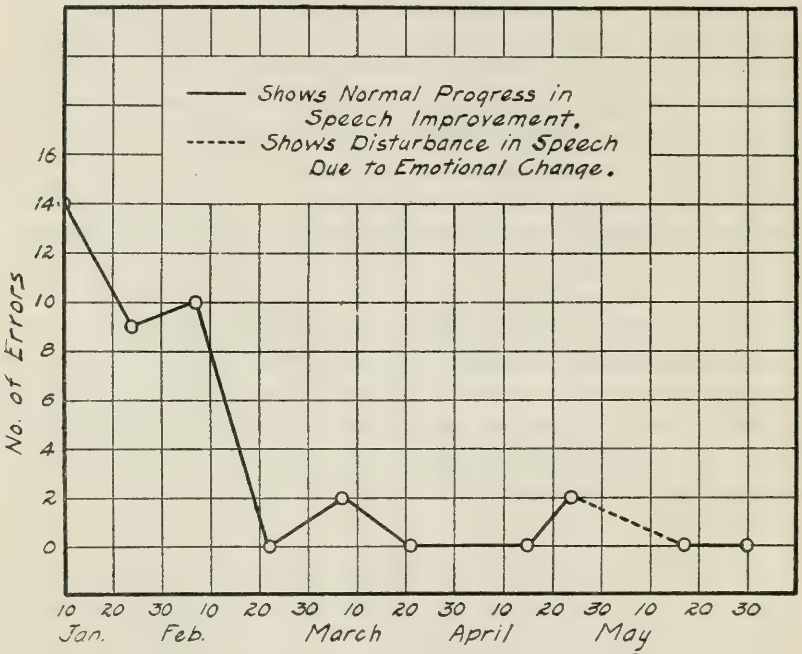
The speech examination indicated a functional disturbance with excessive rapidity and lack of rhythm. During speech there was interference with normal respiration, the hypertonicity being frequently communicated to the muscles of the eye, face, and diaphragm. There were frequent interruptions in the middle of a word or phrase with attempts to speak while an inspiration was taking place. Certain consonants in initial position were pronounced with difficulty and then in an explosive manner, indicating incoördination of the respiratory and vocal muscles. All these difficulties became less noticeable when the child was required to speak slowly.

From these examinations it was apparent that this interrelated group of disturbances could be overcome only by means of general physical upbuilding, combined with specific speech training. Accordingly, Alice was brought to Iowa City and placed in the home of a woman with some training in the care of special cases. Her school program, rest, recreation, and diet were controlled by means of a schedule for every hour of the day. Regular speech training was undertaken for the purpose of establishing normal habits of breath control, of insuring proper formation of vowels and consonants, and of securing a transfer of attention from habitual faults to distinct utterance.



Weight-curve—Alice

The effect of five months in a controlled environment is shown in the accompanying weight chart. In general, there is an increase in weight, although there are three distinct drops in the curve, each corresponding to an occasion of marked emotion disturbance.



Speech-errors—Alice

The result of speech training during these five months is shown in the appended curve of errors plotted from the phonographic test records made by the child at frequent intervals during the elimination of stuttering. This curve shows a gradual reduction of errors, but with lapses in speech control similar to the loss in weight and coincident with the same occasions of emotional disturbance.

The distinct improvement under controlled conditions was so evident that the parents took steps to place this girl in a boarding school where she might continue her speech training and acquire emotional control under close supervision.

Weight of Alice

January 7th	89½ lbs.
February 14th	92¼
March 15th	93¾
March 25th	96
April 4th	93½
April 14th	95⅞
April 25th	95¼
May 6th	97¾
May 13th	98
May 20th	99
May 27th	97
June 4th	97
June 11th	98¼

Phonographic Speech Record of Alice

January 10th to May 30th, 1919

	ERRORS
January 10th	14
January 24th	9
February 7th	10
February 22nd	0
March 7th	2
March 21st	0
April 15th	0
April 24th	2
May 17th	0
May 30th	0

V. MATERIALS FOR SPEECH EXAMINATION

In checking the speech errors of individual children, the examiner uses the accompanying word lists and test sentences containing the consonants in initial, middle and final position; sentences containing the five vowels, long and short; the most common of the difficult consonant combinations; and the diphthongs— -uy, -oy, -ow, -ew.

The particular sounds are arranged in test sentences which are given to the child to be read, while the examiner checks the corresponding word list, underlining the character which gives difficulty or which is inaccurately articulated. The Roman numerals, I, II, III and IV on the examiner's page refer to error types, such

as initial, middle or final consonant, long or short vowel, difficult consonant combination, or diphthong. The Arabic numerals 1 to 46 correspond to the number of the sentence in which listed sound appears.

The date of the first examination is noted, the words missed being underlined on that date. As the errors are progressively eliminated, the columns at the right are to be filled in to show date of first elimination, reappearance of difficulty, and approximate date of final elimination for each sound.

INDIVIDUAL SPEECH RECORD

Date..................... x accurate; o inaccurate

Name ....

Address...

I. Consonants in initial, middle and final position

	ELIM.	REAP.	FINAL ELIM.
1. bear, nibble, stub			
2. cook, baked, cake			
3. Dan, conduct, good			
4. flying, offer, off			
5. goose, again, egg			
6. hopes, harm, hounds			
7. jockey, injured, hedge			
8. key, broken, take			
9. let, dollar, will			
10. must, Emma, some			
11. Nan, dinner, fountain			
12. pack, apples, deep			
13. queen, toque			
14. read, rural, fruit, fire			
15. sit, listen, us			
16. trembled, tattered, blast			
17. very, velvet, have			
18. will, tower, now			
19. exact, inexpert, fox			
20. yellow, merry			
21. zeal, prisoner, cause			
22. children, peaches, lunch			
23. shy, dashing, marsh			
24. wheel, pleasure			
25. that, father, with			
26. thought, author, Smith			

II. Vowels (1), (long)

27. *e*at, c*a*ke, b*i*te
28. *u*se, boat
    Vowels (2), (short)
29. k*i*t, m*e*nd, b*a*t
30. b*o*nd, *u*p

III. Difficult consonant combinations

31. Dwight, twirl, athwart
32. great, crowd, praise
33. fright, brave, track
34. drove, through, spruce
35. mild, melt
36. supple, able, kettle
37. spear, struck, split
38. squire, escape, sword
39. shrink, strike
40. dusk, smooth, snow
41. place, flooded, gloom
42. clouds, blend, sloping
43. gatheri*ng*, stre*ngth*, bri*nk*
44. stands, scrub

IV. Diphthongs

45. G*uy*, t*oy*
46. f*ew*, c*ows*

TEST SENTENCES FOR INDIVIDUAL SPEECH RECORD

1. The bear nibbled at the stub.
2. The cook baked a cake.
3. Dan's conduct was good.
4. He went flying off after the offer.
5. The goose again laid a golden egg.
6. He hopes not to harm the hounds.
7. The jockey was injured in taking the hedge.
8. Take the broken key.
9. Let me borrow a dollar and I will repay you.
10. He must give Emma some candy.
11. Nan ate her dinner by the fountain.
12. Pack the apples in a deep box.
13. The queen wore a brown toque.
14. I read that the fire in rural places spoiled much fruit.
15. Sit and listen with us.
16. He trembled in his tattered garments at the blast.
17. That is very like the velvet which I have.

18. Will he mount the tower now?
19. To be exact, he is an inexpert fox hunter.
20. The yellow glow of the Yule log and merry laughter attracted them.
21. The zeal of the prisoner was used in a poor cause.
22. The children shared their peaches at lunch.
23. The shy creature went dashing through the marsh.
24. The wheel gave him pleasure.
25. I think that your father went with him.
26. I thought the author's name was Smith.
27. You may eat the cake if you will give me a bite.
28. Shall you use the boat?
29. Kit was unable to mend the bat.
30. The bond was locked up in the safe.
31. Dwight twirled the stick athwart the path.
32. The great crowd praised the speaker.
33. The frightened brave fled from the track.
34. They drove through forests of spruce.
35. This mild weather melts the snow.
36. With supple movements he was able to lift the iron kettle.
37. As the spear struck, the armour split in twain.
38. The squire escaped the sword.
39. They shrink from declaring a strike.
40. At dusk the fence was smoothly capped with snow.
41. The place was flooded with gloom.
42. The clouds blend with the sloping horizon.
43. Gathering strength, he drew himself to the brink.
44. There stands a scrub pine.
45. Guy has a new toy.
46. They keep a few cows.

VI. MATERIALS FOR PHONOGRAPHIC TEST RECORDS

Part of the materials used in testing John is here assembled as samples of the method of procedure in speech cases of his type. The tests were usually given at two weeks intervals. Every other test was generally a re-test on the material of the preceding test to note the effect of specific drill on sounds which the test had shown were inadequately produced. This drill was never on the test material itself.

TEST SET 3

(1) Words showing range of tone.
(2) Words showing volume of tone.
(3) Sentences arranged so as to contain sounds of vowels, and consonants used in initial position, the numeral indicating the number of times each

was used, as follows: a(2), b(5), d(3), e(1), f(2), g(1), h(3), i(1), j(1), k(5), l(2), m(1), n(1), p(7), qu(1), r(1), s(2), t(6), th(voiceless, 1), th(voiced, 10), v(2), w(2)—(oo), wh(1), y(1).

1. Patty bought more white wafers.
2. A few fine villages.
3. The tall timbers cover two lots.
4. Come quickly, the cows are in the corn.
5. Verily, he has saved enough to prevent poverty.
6. I think that will do.
7. Does Zeus answer the people thus?
8. Peter paid the price gladly.
9. Ring the library bell.
10. George can bring the bugler's horn.
11. She tried to drill nine youths.
12. The ship bore treasure.

(4) Short selection containing a, e, i, o, oo vowel sounds in initial position. As:—

"Have you seen an apple orchard, in the spring, in the spring? An English apple orchard in the spring? When the spreading trees are hoary with their wealth of promised glory, and the mavis pipes his story, in the spring!"

TEST SET 4

A short story, arranged so as to contain the following consonants and vowels used in initial position, the numbers referring to the number of times each was used: a(13), b(9), d(8), e(2), f(8), g(4), h(16), i(8), j(2), k(4), l(3), m(4), n(2), p(11), qu(1), o(4), o(1), oo(3), r(5), s(7), t(8), u(1), w(13), y(1), ph as f(1), wh(1), th(voiceless, 1), th(voiced, 21).

STORY

Peter, one day, wished to make some trench candles. So he took some wafers of white wax, heated them in a pan until they dissolved into a thin liquid; then he found many of Phillip's thick newspapers. He then bought a quire of plain paper for the outside.

He folded the papers over and back and did not forget the directions. Bringing from his room some strips for wicks, he placed them in the center of each, rolling the paper about it, and jamming it together, he fastened with mucilage the outer edge.

He was going to call George, but remembered that he had gone to choir practice at the church, after the bell rang, and would soon go by on his way back to the shop. It would be more pleasure to show him the result of the work done by one's self, he thought. So he dipped the paper candles in paraffin, and after they dried, he lighted one. It gave forth a dim yellow light.

VII. SAMPLE SPEECH DRILL CHARTS

Long vowels;

CHANT,=SAY,

-LAH-LAY-LEE-LAW-LOH-LOO-

-HAH-HAY-HEE-HAW-HOH-HOO-

-DAH-DAY-DEE-DAW-DOH-DOO-

-MAH-MAY-MEE-MAW-MOH-MOO-

Vowel strengthening.

-ah-AY-EE- AW - OH - OO

-kah-kaY-KEE - KAW-KOH-KOO

Same With n.v.f.t.b.g.

Exercises for Vowel Drill

CONSONANT ATTACK

-AN-AN -AN -AN -AN-AN -CAN

-AT-AT -AT -AT -AT-AT -MAT

-AIN-AIN-AIN-AIN -AIN-AIN-RAIN

-IKE-IKE-IKE-IKE-IKE-IKE-LIKE

- EW - EW - EW - EW - EW - EW -FEW

-URCH-URCH-URCH-URCH-URCH-URCH-CHURCH

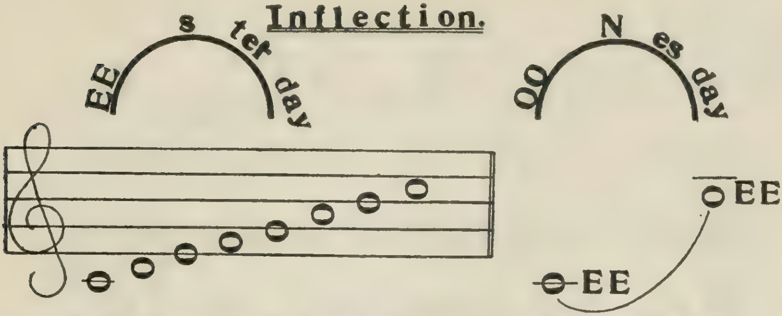
-AM - AM -AM - AM -AM- AM - JAM

-AY - AY - AY - AY - AY - AY - DAY

Same with g.n.b.w.v.t.

Exercises for Consonant Attack; Used Chiefly with Stutterers

Inflection.



- WHO - BELLS - WINDOW
- FALL - HOME - RINGING
- MILL - KIT - QUICKLY
- TEN - PEAL - SISTER

1. ARE YOU GOING HOME TO AY?
2. I SAW YOUR FATHER LAST NIGHT.

Exercises for Developing Inflection

Speech Building.

1. The top------------. —6. Where is my-----?
2. The girl----------- . —7. Who is----------?
.The ice ------------. —8. May I go-------- ?
4. The store----------. —9. I have a—and a—.
5. The top-----------. —10. He bought a—and a—

Linking.

1. John found a new top.
2. John found a new top and a pencil.
3. John found a new top, a pencil, and a book.
4. John found a top, a pencil, a book, and a map.

Exercises for Speech Building; Used in Stimulating Spontaneous Speech
Exercises in Phrase Linking; Used in Work for Smooth, Rhythmical Speech

Chant;
Say;
Shout; —OLD KING COLE
WAS A MERRY OLD SOUL.
—GREAT, WIDE, WONDERFUL, BEAUTIFUL WORLD!
—WITH THE WONDERFUL WATER ROUND YOU CURLED:
—AND THE WONDERFUL GRASS UPON YOUR BREAST,
—WORLD, YOU ARE GRANDLY AND BEAUTIFULLY DRESSED.

Exercises Used for Vowel Drill on the Rounded Vowel Sounds o, oo and the Diphthong eoo

WORD DRILLS.

Initial.		Final.		Middle.	
–meat	–name	–aim	–fine	–amaze	–sense
–make	–nine	–hum	–moon	–dreamer	–any
–my	–not	–comb	–can	–summer	–money
–must	–need	–foam	–seen	–tramp	–sooner
–move	–number	–hem	–ton	–hammer	–dinner

–The murmur of music makes him calm.
–The murmuring pines and the hemlocks.
–To him, money seems most important.
–Count out nine new coins.
–John ate his dinner by the fountain.
–The negro nurse crooned an ancient melody.

Specimen Chart Using m, n, in Initial, Middle, and Final Position in Words and Sentences; Similar Charts Are Used for All the Consonants

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FIRST SERIES NO. 48 MAY 1, 1921

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 4

ANALYTIC STUDY OF A GROUP OF FIVE AND SIX-YEAR-OLD CHILDREN

BY

Clara H. Town

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rates of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918

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PROFESSOR BIRD T. BALDWIN, PH. D., EDITOR

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The Studies in Child Welfare are listed at moderate prices, but are sent free on request to persons who are actively engaged in child welfare work in the state. The Bulletins on the Aims and Progress of Research in Child Welfare may be obtained free of charge from the Librarian of the University. Extension Division Bulletins may be secured free of charge upon application to the University of Iowa Extension Division.

CONTENTS

EDITOR'S FOREWORD

This is a preliminary investigation for a more comprehensive program the Research Station has outlined, covering a series of years, and aiming to determine *what kind of children the Iowa homes are sending to the Iowa schools.* Dr. Town made a series of observations and experiments from many angles on 52 children during the first months of their school life, with the direct help and coöperation of the staff of the Station, members of the Medical and Dental Colleges, the Graduate College, and the school authorities of Cedar Rapids.*

Few physical, mental and social tests are available for use with such young children, and many of those which are applicable are not standardized. Several of the tests were found to be too easy and showed an undistributed maximum score; others were too difficult and showed an undistributed zero. With a few cases there resulted a complete failure to understand the directions of the test, and no score was made. These facts show that some new experiments and different standards with more specific technique will be necessary for the further studies which are contemplated.

In the absence of norms, the performance of each child is compared with the percentile score of the group. For convenience of treatment, the psychological tests are grouped under descriptive terms such as imagination, memory and perception. This should not be taken to mean that any general ability which could be designated by such terms, was being tested. The charts and type cases attempt to give a synthetic, synoptic picture of twelve children.

*The medical examination was made by Dr. J. J. Terrall, a local physician of Cedar Rapids. The dental examination was made by Dr. E. A. Rogers and Dr. R. W. Rogers of the University of Iowa College of Dentistry. The tests for auditory acuity and pitch discrimination were given by Mr. H. M. Halverson of the Department of Psychology, University of Iowa. The speech examination was made by Miss Sara Stinchfield of the Iowa Child Welfare Research Station. The other measurements were made by Dr. Clara H. Town. Special mention should be made of the assistance of Dr. Carl E. Seashore and Dr. Ellsworth Faris of the University in planning and carrying out the investigation during the Director's absence in the service of the United States Army. Dr. Town was unable to complete the investigation during her appointment as Research Associate. The Director, therefore, assumes the responsibility for a number of minor changes and eliminations which it seemed desirable to make when preparing the manuscript for publication. In this work he has had the assistance of Dr. Lorle I. Stecher. Dr. Town, who is now in France, has read and approved the final manuscript.

The investigator was given as much freedom as the general program would permit, and the tests selected, the traits measured and the technique in several instances have been determined by her interest and training and the accessibility of the materials and methods.

The present problems of the Research Station lie in two distinct directions: (1) The elimination of some of the tests, the addition or amplification of others, the further consecutive scientific analysis of the most fertile experiments, and the examination of additional pre-school children, with a view to an ultimate survey of the complete child from several aspects, and (2) the organization and stimulation of a remedial program for these and similar children who are representative of the large mass of five and six year old children of Iowa. It is a most significant fact in this *Study* that not a single child was found to be free from mental or physical defects.

BIRD T. BALDWIN

Office of the Director
Iowa Child Welfare Research Station
University of Iowa
October 1, 1920

ANALYTIC STUDY OF A GROUP OF FIVE- AND SIX-YEAR-OLD CHILDREN

I. INTRODUCTION

As a part of the year's research for 1918-1919, the Iowa Child Welfare Research Station planned a comprehensive study of little children who had just reached school age but who had not yet been modified by school influences. The underlying thought was, that could the schools obtain, when a child is first entered, an adequate knowledge of his abilities and disabilities, strengths and weaknesses, both mental and physical, they could make a more intelligent attempt to plan the first years of his school life.

That improvement is needed in the school procedure during these first formative school years is evidenced by the large number of children who repeat the kindergarten and the first and second grades. In the 1915-1916 report of the Cedar Rapids schools the percent of nonpromotions in the kindergartens is given at 27.4 per cent, in B-first 16.6 and in A-first 16.8. In the 1918 school report for Denver, Colorado, the retardation in the first grade amounted to 44 per cent, and in the second grade, 52 per cent. This retardation is based on age. If retardation starts thus early the causes for retardation must already be present, and if these causes are discovered at the beginning of the child's school life there is a possibility of eliminating the retardation before permanent harm is done.

As it seemed impossible to secure the children for the purpose of study in any other way than through the public schools it was decided to direct our studies to classes just beginning school, classes composed of children who, though they had entered school, were very nearly home products. The general plan of the Research Station is to study several such groups in representative sections of some one Iowa city and later to extend the study to include cities in various sections of the state and also country schools. It is hoped that in this way it will be possible to discover what sort of children the Iowa homes send to the Iowa schools. This study

presents the results from one class in Cedar Rapids, the research extending over a period of six months.

Though not modified by school influence, these children have already been modified by home influence. Each little child of the group is the result of six years of development under a home influence differing from the home influence acting upon every other child of the group. At six years of age, although potentialities of some adult abilities have not yet manifested themselves in conduct, children are already highly differentiated individuals with dominant tendencies of character and temperament. Many innate tendencies have appeared, which have been fostered, curtailed or shunted into diverse channels of activity by the influence of home environment or discipline. Many habits, of both body and mind, have been acquired. In short, at six years, children are already so highly individualized that it is no longer justifiable when referring to them to speak of "the child" but better to speak of "the children."

The plan was not, therefore, to study our children in groups, but to analyze each complex individual in the group. It was part of the plan to learn as much as possible about him physically—the development of his body and its parts, the functionings of his circulatory, respiratory, digestive, glandular and nervous systems, the state of his nutrition, the condition of his sense organs and the adequacy of his motor power and control. It was a part of the plan to learn as much as possible about him mentally—the stages of development of his various mental processes, his habits, instincts, impulses, temperamental tendencies and dominant traits of character. It was also part of the plan to find out what he had experienced during his five or six years of life, on the physical side—his illnesses, his privations, his indulgences, the character of his food, shelter, clothing and general environmental experiences—and on the mental side, the home influences—emotional, aesthetic, intellectual, religious, moral and disciplinary.

This accumulation of facts relating to a child as he was in the beginning and as he has been during the first five or six years when compared with our findings as to what he is at the end of these years should tell something of the experiences and influences which have made him what he is. Such studies when repeated with each of a large group of children should do something toward

pointing out what sort of experiences and influences tend to produce a satisfactory type of six year old and what sort of experiences and influences tend to produce a defective or handicapped type of child.

The collected facts from a small typical group should also contribute to our knowledge of the number of children who are defective physically or mentally when they enter school and to our knowledge of the nature of these defects. They should do much to show whether the defects noted in so many children after two or three years' experience of school life and sometimes attributed to school life itself, are already present in the child prior to any school experience.

The following pages contain a record of the studies made of fifty-two children in one class in Cedar Rapids, Iowa. The report naurally divides itself into sections on the physical findings, (physical examinations, anthropometric measurements and speech examinations), a section on the mental findings and a section on the social findings, consisting of sketches of individual children. An analysis of the tabulated results of the physical findings brings to light some rather startling conditions. Most startling of all, perhaps, is the fact that every child in the group is in need of physical help of some sort.

II. PHYSICAL EXAMINATION

The physical examination of each child comprised a general inspection of the body,* a medical and dental examination, together with tests for visual and auditory acuity and pitch discrimination.

1. *Medical Examination*

Outline

Skeletal Development
Muscular development
Skin and appendages
Glands
Respiratory System
    Upper respiratory tract
    Rate of respiration
Chest
    Inspection

*The eye color was also classified and recorded according to the directions and chart given in the *Trait Book* published by the Eugenics Record Office, Bulletin 6.

TABLE I (1)

Child Number	Age in Years	Acuity in Vision R	Acuity of Vision L	Binocular Incoordination	Auditory Acuity R (Whisper) (a)	Auditory Acuity L (Whisper)	Auditory Acuity R (Audiometer) (b)	Auditory Acuity L (Audiometer)	Pitch Discrimination	Tympanic Membrane Dull R	Tympanic Membrane Dull L	Enlarged Cervical Glands	Enlarged Inguinal Glands	Enlarged Cubital Glands	Tonsils, Enlarged or Diseased	Adenoids, Enlarged	Lungs, Rales	Von Pirquet Test	Pulse Rate	Heart Murmurs	Haemoglobin	Urine, Acid or Alkaline	Urine, Specific Gravity
1	5	4/10	1/10	+	87	77	0	0	0						+				120		75	Alk.	1030
2	5	10/10	10/10		108	99	37	27	17						+	+			104	+	95		
3	5	8/10	8/10		97	99	30	25	12			+	+		+	+			80	+	83	Alk.	1023
4	5	10/10	10/10		108	99	25	23	2			+			+	+			104			Ac.	1010
5	5	10/10	10/10		97	99	21.3	21	2			+			+	+							
6	5	8/10	4/10	+	87	99	27	27	3			+				+			116		66	Alk.	1020
7	5	10/10	10/10		76	109	26.6	22.6	12										100		75	Alk.	1022
8	6	10/10	10/10		87	77	27.3	23.3	12			+			+	+			112		72	Alk.	1015
9	5	4/10	8/10		97	109	27.6	32.3	3												75		
10	6	10/10	10/10		76	77	22	26	8			+			+	+			100		76	Alk.	1026
11	5	4/10	1/10		97	109	23.5	19	0				+		+			P	104		76	Alk.	1022
12	5	6/10	6/10		87	99	26	25.6	8	+		+	+		+	+	+		120	+	81	Alk.	1020
13	6	6/10	6/10		108	80	18.6	20.3	8			+	+		+					+	80	Ac.	1017
14	6	8/10	8/10		108	109	14.3	23	17				+		+				128		75	Alk.	
15	7	8/10	6/10		97	109						+					+		112	+	73		
16	5	10/10	10/10																				
17	5	6/10	6/10	+	108	109	21.3	29	3										100		71	Ac.	1018
18	5	8/10	10/10	+	97	109	24	23.6	3			+	+		+	+					78	Ac.	1008
19	5	6/10	8/10		108	109	26	25.3	3			+			+				116	+	78	Ac.	1010
20	5	8/10	8/10		97	109	26	26.6	8										100		76		
21	6	10/10	10/10		108	109	28	29	0			+				+			108		85	Alk.	1035
22	5	8/10	8/10		108	109	25.6	25.3	12										112	+	73	Alk.	1025
23	5	8/10	8/10	+																			
24	6	10/10	10/10		108	109	20.5	20.5	2			+	+		+	+	+		112	+	75	Alk.	1026
25	5	10/10	10/10		108	109	25	25.3	8										100		74	Ac.	1027
26	5	10/10	10/10	+	108	109	26.3	30	5		+					+			92	+	83	Alk.	1023
27	5	10/10	10/10	+	65	43	26	27.5	17			+	+								78	Alk.	1020

TABLE I (2)

Child Number	Age in Years	Acuity of Vision R	Acuity of Vision L	Binocular Inco-ordination	Auditory Acuity R (Whisper) (a)	Auditory Acuity L (Whisper)	Auditory Acuity R (Audiometer) (b)	Auditory Acuity L (Audiometer)	Pitch Discrimination	Tympanic Membrane Dull R	Tympanic Membrane Dull L	Enlarged Cervical Glands	Enlarged Inguinal Glands	Enlarged Cubital Glands	Tonsils, Enlarged or Diseased	Adenoids, Enlarged	Lungs, Rales	Von Pirquet Test	Pulse Rate	Heart Murmurs	Haemoglobin	Urine, Acid or Alkaline	Urine, Specific Gravity
28	5	10/10	10/10		97	109	28.6	24.3	0			+	+		+	+					76	Ac.	1025
29	5	10/10	10/10	+	108	109	28	27	5		+		+		+				120				
30	6	10/10	10/10		108	109	20.6	20.3	12						+				112		67		
31	5	4/10	4/10		97	99									+	+			120				
32	7	10/10	10/10		87	80	34.5	31.5	8						+						80	Alk.	1026
33	5	4/10	4/10		108	80	29	27	3			+	+		+	+			120		86	Ac.	1018
34	6	10/10	10/10		108	109	18.5	15.3	2				+		+	+			112		73		
35	5	6/10	10/10		108	80	24.6	25.3	0			+	+	+	+	+			104		76	Ac.	1026
36	6	10/10	10/10		97	80	26	29	8			+	+		+		+		120		81		
37					97	80																	
38	5	10/10	10/10		97	109	30.5	31.5	17												67		
39	5	10/10	10/10		108	109	29.6	28	0										120		70		
40	5	10/10	10/10		108	109																	
41	5	6/10	8/10																				
42	5	10/10	10/10		108	99	26.6	19	0						+	+			92		73	Ac.	1024
43	5	6/10	8/10	+	108	99	19.5	27	12		+	+			+				104	+	75	Ac.	1012
44	5	10/10	10/10		97	109						+			+	+	+		104		77		
45	5						30.3	29.3	0			+	+		+				96		75	Alk.	1016
46	4																						
47	5	6/10	6/10		97	99	24.3	24.6	0			+	+						104	+	72	Ac.	1018
48	5	6/10	10/10	+			26	25.5	0			+							120		75		
49							26.6	28	0														
50	5	10/10	10/10		97	99	27.6	24.3	0			+	+		+	+			104		76		
51							27.5	26.6	0														
52	6			+			20	18	12														
53							24.3	28	0														

(a) Norm. Right Ear 92 Left Ear 91

(b) Average Right Ear 25.3 Left Ear 24.8.

TABLE I (3)

Child Number	Urine, Sugar	Urine, Albumin	Urine, Acetone	Urine, Indican	Circumcision Needed	Flat Foot	Bowed Legs	Scoliosis	Lordosis	Scapulae Prominent	Left Handed	Eye Color	Temporary Teeth Lost	Permanent Teeth Erupted	Temporary Teeth Carious	Temporary Teeth Abscessed	Permanent Teeth Carious	Permanent Teeth Abscessed	Extraction Recommended	Mal-occlusion	Cleaning by Dentist Needed	Tooth Brush Owned	Teeth Already Filled
1	0	0			+	+	+			+	+	2	0	0	11	0	0	0	0	0	+	0	0
2												2	0	0	0	0	0	0	0	0	0	+	0
3	0	0	0	0								2	0	0	2	0	0	0	0	0	0	+	0
4	0	0				+				+		6	2	6	5	0	3	0	0	+	+	+	0
5										+		6	2	6	8	0	2	0	0	+	+	+	0
6	0	+	0	0								2	0	2	4	1	2	0	1	0	+		0
7	0	0	0	0				+		+	+	2	2	0	5	1	0	0	1	0	+	0	0
8	0	0	0	0	+					+		2	2	4	6	0	0	0	0	0	+	+	0
9												2	0	2	14	0	0	0	1	0	+	+	0
10	0	0	0	0		+						2	2	2	8	1	0	0	1	3	+	0	0
11	0	0						+				2	2	0	2	0	0	0	0	0	+	+	0
12	0	0								+	+	2	0	6	0	0	0	0	0	0	0	+	0
13	0	0			+			+	+			2	4	2	3	0	0	0	0	0	+	+	0
14	0	0				+			+			6	0	2	4	0	0	0	0	0	+	+	0
15										+		2											
16												2											
17	0	0	0	0								2	0	0	0	0	0	0	0	0	+	+	0
18	0	0								+		3	0	0	2	0	0	0	0	0	+	+	0
19	0	0	0	0						+		2	0	0	12	1	0	0	1	0	+	+	0
20												3	0	0	0	0	0	0	0	0	0	+	0
21	0	0								+		3	3	4	9	2	0	0	2	0	+	+	0
22	0	0					+				+	6	0	0	9	0	0	0	0	0	+	0	0
23													0	0	2	0	0	0	0	0	+	+	0
24	0	0								+		6	1	4	7	0	0	0	0	0	+	0	0
25	0	0								+	+	4	0	1	11	1	1	0	1	0	+	+	0
26	0	0									B	6	0	0	5	0	0	0	0	0	+	+	0
27	0	0			+			+			+	6	0	0	11	1	0	0	1	0	+	0	0

TABLE I (4)

Child Number	Urine, Sugar	Urine, Albumin	Urine, Acetone	Urine, Indican	Circumcision Needed	Flat Foot	Bowed Legs	Scoliosis	Lordosis	Scapulae Prominent	Left Handed	Eye Color	Temporary Teeth Lost	Permanent Teeth Erupted	Temporary Teeth Carious	Temporary Teeth Abscessed	Permanent Teeth Carious	Permanent Teeth Abscessed	Extraction Recommended	Mal-occlusion	Cleaning by Dentist Needed	Tooth Brush Owned	Teeth Already Filled
28	0	0			+			+			B	2	1	0	7	0	0	0	0	0	+	0	0
29										+		3											
30												2	0	0	7	0	0	0	0	0	+	0	0
31																							
32	0	0	0	0									1	7	3	0	2	0	1	0	+	+	0
33	0	0				+				+		2	0	4	1	0	0	0	0	0	+	+	2
34						+						3	0	0	9	1	0	0	0	0	+	+	0
35	0	0											0	0	6	0	0	0	0	0	+	+	0
36												4	0	0	3	0	0	0	0	3	+	+	0
37										+			0	2	5	1	0	0	1	3	+	+	0
38					+					+			0	0	0	0	0	0	0	0	0	+	0
39										+			0	0	4	0	0	0	0	0	+	0	0
40																							
41													0	0	3	0	0	0	0	0	+	0	0
42	0	0	0	0						+	B	5	0	0	3	0	0	0	0	0	+	0	0
43	0	0	0	0							+	2	0	0	0	0	0	0	0	0	0	+	0
44												6	0	0	1	0	0	0	0	0	+	+	0
45	0	0	0	0									0	1	12	3	0	0	0	0	+	+	0
46																							
47	0	0	0	Tr.								4											
48					+	+				+		2											
49																							
50						+						3	0	0	2	0	0	0	0	0	+	+	0
51													0	0	4	2	0	0	0	0	+	+	0
52						+						4											
53																							

- Palpation
- Percussion
- Auscultation
- Von Pirquet when indicated

Circulatory system
- Pulse rate: standing and sitting
- Regularity of beat
- Quality of beat
- Arteries
- Veins
- Heart
- Blood
- Wassermann when indicated

Genito-urinary
- Examination of urine-sugar, albumin, indican, acetone
- Sexual abnormalities

Nervous system
- Sense organs
- Deep sensibility: nerve trunks, muscles, sense of position and passive movements, and tension

Coördination
- Tremors, tics, automatisms, chorea, convulsions
- Reflexes
  - Superficial
  - Deep

A number of points merit comment in connection with the physician's findings. In the lung examination, rales were detected in 5 cases out of 43. These are not necessarily an indication of tuberculosis, as rales may be due to an acute and transient disorder only. Only 1 out of 11 children whose parents consented to a Von Pirquet test showed a positive reaction and this was not a child in whom rales had been detected. A positive von Pirquet may, moreover, be obtained after the active tuberculous condition has passed. Enlarged lymphatic glands were present in 41 out of 43 children. This, again, is not to be taken as indication of tuberculosis, since this glandular condition may accompany diseased tonsils or adenoids or decayed teeth, all of which conditions occurred in a large number of this group of children.

In the heart examination, murmurs were found to be present in 11 cases. A heart murmur found in an examination is no more a conclusive proof of organic heart lesion than is the presence of rales a conclusive proof of tuberculosis. Heart murmurs are sometimes the result of anaemic conditions, and to judge of

their significance it is necessary to consult the symptoms indicative of the state of nutrition—the haemoglobin content, the height-weight record, etc. Many pulse rates were rapid, but this was manifestly due to excitement at being examined.

The haemoglobin content was measured with a Sahli haemometer. In a well-nourished individual approximately 14 per cent of the blood stream is haemoglobin. This amount is represented on the scale of the instrument used by 100. Dr. Cabot considers 80 as the average for children from 5 to 15 years, and Dr. Josephine E. Young, in a study of children at the School of Education, University of Chicago, secured an average of 77 for boys from 6 to 11 years, and an average of 80 for girls from 6 to 17 years of age. If our data are comparable with Dr. Cabot's, 30 of our 39 children have a haemoglobin content below the average. Only one of our group reached a content of over 86. This child's haemoglobin was 95. The lowest ratings were 66 and 67; 27 cases fell between 70 and 80 and 8 between 80 and 90. It would seem, however, that the very method of the haemoglobin test would make accurate comparisons between data secured by different individuals almost impossible. The exact matching of color required by the test makes the reading depend upon the accuracy of the color perceptions of the examiner. This accuracy, of course, varies with individuals, and the personal equation is therefore largely contributory to the results obtained. The haemoglobin content, moreover, is only one of many methods of estimating malnutrition, and to be of value should be considered in connection with height-weight, condition of skin, etc. When we compare the haemoglobin content with the height-weight record we find that 18 of the 30 children having a haemoglobin content under 80 are underweight. (Table I.) In connection with all these medical data, it is of interest and value to note the anthropometric records in order to see how a child's general physical development and weight-height index are correlated with the physician's findings.

An effort was made to inform the parents of the results of the examinations, both by parents' meetings and by visits to the homes. Intelligent coöperation in remedying defects was almost always secured. It appeared in most cases that the parents were unaware of the child's condition and expressed great satisfaction that the child was having a thorough examination.

2. *Acuity of Vision*

As the children were still unable to read, it was necessary to use for testing visual acuity an "illiterate test." The E charts on the market are unsatisfactory in two particulars: first, there are so many E's on the chart that a young child has difficulty in centering his attention on the particular E to which the examiner points; second, it is quite possible for some children to learn the order of the positions on the card while the first eye is being tested, which of course vitiates the test for the other eye. To eliminate these difficulties, a set of white cards five inches square was prepared, in the center of each of which was mounted an E cut from the E chart. On the back of the chart was written the amount of vision necessary (20/20, 8/10, etc.) to see that letter at twenty feet, and also the position of the E on the reverse side. The examiner stood at a distance of twenty feet from the child, held the pack of cards in an upright position and exposed one at a time for the child to observe. The child was asked to point in the direction that the E pointed and was given a little practice in doing so at close range before the test was taken. If he failed to grasp the idea of the pointing method, he was given a cut-out E the size of the largest E and asked to hold it so that it looked like the E on the card. One or the other method usually brings a satisfactory response unless the child is an imbecile of the excitable type. The eyes of 47 children were so tested, and 22 (47 per cent) were found to have defective vision. (Table I).

The Maddox rod test for binocular coördination revealed the fact that 4 children who had average acuity of vision by the E test showed marked incoördination of the eye muscles as did also 6 of the 22 who had diminished acuity. Such incoördination would interfere materially with the process of learning to read. These visual defects were present when the child entered school and were not due to strain sustained at school through poor lighting, blackboards, small print, etc. It is obvious that all children should be tested upon entering school in order that such conditions may receive attention before further strain interferes with general health and school progress.

3. Acuity of Audition

The acuity of hearing was tested by two methods: the whisper method and the Seashore audiometer. In the whisper test (Andrews' method) the stimuli are special lists of number words prepared by Andrews.[1] The whisper was kept as uniform as possible by always using for it the residual air after a deep inspiration and expiration. Each ear was tested separately, a piece of cotton being placed in the external meatus of the ear not being tested. The child was seated with the ear in line with the examiner, eyes looking straight ahead, and told to "Say just what I say." It is sometimes necessary to explain very fully what is desired; one child so persistently said a totally different number than the one spoken by the examiner that misunderstanding was suspected and it was discovered that she thought we were playing a kind of game in which the examiner thought of a number and then she thought of a number.

The percentage of successful repetitions for each ear was recorded. After the whole group had been tested, the mean performance for each ear was found and this was used as a norm with which each child's performance was compared. The child's score was computed in terms of per cent of these norms. If a child made no error his score was of course above the average, and therefore necessarily above 100 per cent. A perfect performance with the right ear equaled 108, the average for the group being 92. A perfect performance with the left ear equaled 109, the group average being 91. Only two very low scores were obtained: one was right ear 64 per cent, left ear 43 per cent; the other, right ear 76 per cent, left ear 77 per cent. The latter is an adenoid case; the former's source of trouble has not been ascertained. The findings are presented in Table I. It was found necessary to examine ears for wax before testing and to wash out many. Otherwise, the wax deposits acted as stoppers and reduced the hearing.

The acuity of hearing was tested with the Seashore audiometer. For testing these children the audiometer was wired in series with one dry cell, a rheostat being introduced to keep the voltage constant at 0.8 volts. The sound is conveyed to the children's ears by telephone receivers and each ear is tested separately. The sounds

are produced in descending order from loudest to softest and then in ascending order, and the child is told to say "Now" or to nod the head when he hears it. With our little children only the descending order was used, as the children found it hard to fixate their attention upon the sound and it was difficult to hold them for more than three readings with each ear. Unavoidable noises from the street and school rooms distracted them somewhat. Three readings were secured for each ear and these were averaged to obtain the score. The highest readings in absolute numbers are the lowest scores because the highest numbers represent the louder sounds. There are no norms for children with which to compare our findings except our group average obtained from 44 children, which is: right ear 25.3, left ear 24.8. The average adult hears down to 12. The scores are presented in Table I, and may be compared directly with these averages. With the right ear, the poorest score, 37, was that of child No. 2, with 108 in the whisper test, and the next lowest, 34.5, was that of child No. 32, who made 87 in the whisper test. The best scores, 14.3 and 18, were made by children No. 14 and No. 52; child No. 14 made 108 in the whisper test and child No. 52 was not tested. One boy failed entirely who made scores of 87, right ear, and 77, left ear, in the whisper test. This boy was, however, a peculiar child, made reticent by a speech defect, a boy who would not be apt to respond until he was thoroughly familiar with the environment and the examiner.

The children were also tested for pitch discrimination, by means of resonators and tuning forks, varying from 435 v. d. to 465 v. d. by the steps ½, 1, 2, 3, 5, 8, 12, 17, 23, and 30 in terms of vibration difference. In regular procedure the standard fork is sounded, then another, and the subject is asked to state whether the last tone is higher or lower than the first. As children of five years as a rule do not know the meaning of high and low in relation to sound, they were asked to sing the sound they heard. The frequently occurring exaggerations of interval by the children, if in the right direction, were taken to mean that the children really appreciated the difference in pitch. The least difference in pitch that the child distinguished with certainty was recorded as the score. The variations in the findings are so great that the group norm is useless. The scores vary from

2 to 17 vibration differences, with 13 total failures. The individual scores are given in Table I. The singing ability of the children was also judged by listening to each sing any little song he happened to know. The examiner noticed that there were as many ways of singing a song as there were children to sing it, and that the little ones had individual variations to which they clung. He also noticed that many of them had difficulty in changing from one tone to another when the difference was a half or whole step, or in some cases when the difference was a greater step.

4. *Dental Examination*

The dental examinations were made in a special room to which the children were brought one or two at a time. The examination charts were filled out at the dentist's dictation. The tabulated records are given in Table I. They show in 43 children 220 carious teeth, 15 abscesses and 5 cases of malocclusion. The teeth of 36 children needed cleaning by a dentist. Probably as a result of a school health crusade in progress at the time, 31 children had toothbrushes. Only one child had had a tooth filled, though the number of carious teeth, as previously mentioned, was 220. Apparently these conditions are due to the deplorable belief found among parents and even among some dentists that the condition of the first teeth does not matter because they will soon come out. The remedy would seem to be a school dental clinic.

To sum up the physical situation, every child in the group is in need of physical help and all but one in need of medical attention for more than one condition. Eight defects were found in each of two children, seven in each of five, six in each of eight, five in each of seven, four in each of five, three in each of nine, and two in each of six children. These children were not, however, from the poorest class of society, but lived in comfortable homes and had as much physical care as the children of the average working man receive. The appended type study sketches indicate the character of their environment. In spite of this, they were handicapped by the defects and malnutrition noted and were in poor physical condition for meeting the strains of school work.

III. ANTHROPOMETRIC MEASUREMENTS

"If in the future a scientific pedagogy is destined to rise, it will devote itself to the education of men already rendered physically better through the agency of the applied positive sciences, among which pedagogical anthropology holds first place." So writes Montessori in the introduction to her *Pedagogical Anthropology.* In it she not only brings together an immense amount of anthropological data, but clearly points out that the school is the field in which anthropology may step beyond the limits of pure speculation and diagnosis and actually contribute toward the practical work of bringing school children up to the ideals of bodily form set by itself.

Physical anthropology concerns itself with gathering data on bodily form. Anthropology as applied to education concerns itself with gathering data on the developmental stages of form and variations of these. In process of the work it discovers variations from the usual in an individual child's development and points the way for ameliorative treatment before the parts of the body become fixed and set in faulty fashion, too often accompanied by just as faulty organic functioning. Thus pedagogical anthropology adds to the research function of anthropology a practical application which will be far-reaching in its effect upon the well-being of the present generation.

For a concrete illustration, if we find a child is too narrow chested and we know that with such a chest the lungs cannot develop or function as they should, that chest measurement is taken as a basis for special training and exercise which may, if it is begun in time, lead to the development of the chest and the saving of the child from tuberculosis.

Special stress is laid by anthropometrists upon the relation of various measurements to one another. For example, the ratio between sitting height and the height known as index of stature, is considered by many to give more information concerning bodily power and strength than either absolute measurement. For example, Montessori holds that the essential height is the sitting height because this measurement includes the trunk in which the vital organs are situated. According to her, the greater the size of the trunk in proportion to the height, the more room there is

TABLE II (1)

Child Number	Sex	Age	Birth Month	Height in Cm.	Sitting Height in Cm.	Index of Stature	Weight in Kgm.	Weight-Height Index	Chest Circumference	Vital Index	Chest, anteroposterior diam.	Chest, transverse diam.	Chest Index	Arm Span	Span-Height Index	Head, Greatest Length in Cm.	Head, Greatest Breadth in Cm.	Head, Aural Height in Cm.	Head, Circumference	Cephalic Index	Head, Capacity
1	B	5	5 '13	102	62.5	61.27	18.5	.181	54	52.94	12	17.3	69.31	105.5	103.4	17.3	14.5	12.9	50.75	83.8	1269
2	G	5	3 '14	111	64	57.65	23.1	.208	59	53.15	13.4	16.7	80.23	107.5	98.7	18.4	13.7	12	51.5	74.4	1206
3	G	5	11 '13	110.5	61.5	55.65	21.5	.194	54.5	49.32	12	13	92.3	106	95.9	17.3	14.4	11.1	57	83.5	1132
4	G	5	4 '13	116	61.5	53.01	19.4	.167	52	44.82	12.3	16.[illegible]	73.21	115	99.1	18.5	13.6	12.6	52	73.5	1248
5	G	5	4 '13	115.5	61.5	53.22	19.4	.167	55	47.61	12	16.5	72.72	115	98.7	17.8	13.8	12.7	51	77.5	1235
6	B	5	3 '13	114	60.25	52.85	19.0	.167	54	47.36	13	17	76.47	111.2	97.5	16.8	13.4	12	50	79.7	1115
7	B	5	2 '14	101	53.7	53.16	14.7	.146	55	54.45	13.5	15.1	89.40	98	97.0	17.1	13.2	13.3	49	77.1	1201
8	B	6		118.5	67.5	56.9	22.6	.190	54	45.56	13.4	17.5	76.57	116	98.7	17.5	13.5	12.3	50	77.1	1173
9	G	5	4 '13	109.5	62.5	57.07	21.7	.197	56.5	51.59	13.8	17.3	79.76	108	98.6	17.6	14.4	12.2	50.5	81.8	1226
10	B	6	11 '12	114	61	53.5	20.3	.178	57	50	12.6	17.6	71.59	109.5	96.0	17.4	14.2	11.9	52	81.6	1183
11	G	5	6 '13	105	56	53.3	17.3	.165	54	51.42	12.1	15.7	77.07	101	96.1	17.3	13.2	11	49.5	76.3	1059
12	G	5	5 '13	111.5	60.9	54.61	18.5	.165	54	48.43	13.5	17.7	76.27	106	95.0	16.4	13.4	12.6	48.5	81.7	1135
13	B	6	10 '12	116	64.6	55.51	23.1	.199	59.5	51.29	13.6	23.6	57.62	118	101.7	18.7	14.1	12.4	54	75.4	1277
14	G	6		107.5	61.6	53.7	17.7	.164	53	49.3	11.3	18.3	61.74	106	98.6	17.2	13.4	11.4	49.5	77.9	1093
15	G	6	12 '12	107.3	56	52.09	16.3	.152	53	49.4	12.7	14.5	87.58	105	98.7	16.6	13.4	12.6	49	80.7	1144
16	G	5														16.3	12.5			76.6	
17	G	5	'13	100	54	54	15.7	.157	50.5	50.5	12.3	16.8	73.21	198	98	17.3	14.7	12.2	52	84.9	1230
18	G	5	5 '13	108.5	60.8	56.03	18.1	.166	52.5	48.38	14.3	16.3	87.73	106	97.6	16.1	14	11.8	48	86.3	1103
19	G	5	10 '13	101.3	55	54.29	15.8	.156	50	49.35	12.3	17.3	71.09	95	93.7	17.3	13.8	11.8	50.5	79.7	1147
20	G	5	2 '14	106.5	59	53.39	16.7	.156	54.5	51.17	12.6	15.7	80.25	100	93.8	16.5	13.8	11.7	49	83.7	1104
21	B	6	10 '12	106	61.6	58.11	16.3	.154	54.5	51.41	11.6	17.4	66.66	104.5	98.5	18.3	14.5	13.1	53.5	79.2	1338
22	B	5	3 '13	116.5	65	55.69	20.8	.178	57.5	49.35	14	16.7	83.83	115	98.7	18.1	14.2	14.2	53	78.4	1389
23	B	5		102	55.7	54.60	16.0	.157								17.3	13			73.4	
24	G	6	3 '13	110.5	56.4	51.04	19.4	.175	57	51.58	13.2	17.4	75.86	103	93.2	17.5	13.4	13.9	51.5	76.5	
25	G	5	2 '14	104	54.3	52.21	14.4	.138	49	47.11	11.4	15.4	74.02	99.5	91.8	17.3	13.5	11.4	50	78	1276
26	G	5	2 '14	115	64.5	56.08	20.3	.177	54	46.95	12	17.5	68.57	110	95.6	17.3	14.2	13.8	51	82	1314

TABLE II (2)

Child Number	Sex	Age	Birth Month	Height in Cm.	Sitting Height in Cm.	Index of Stature	Weight in Kgm.	Weight-Height Index	Chest Circumference	Vital Index	Chest, anteroposterior diam.	Chest, transverse diam.	Chest Index	Arm Span	Span-Height Index	Head, Greatest Length in Cm.	Head, Greatest Breadth in Cm.	Head, Aural Height in Cm.	Head, Circumference	Cephalic Index	Head, Capacity
27	B	5	12 '13	101	58	57.42	16.7	.165	52	51.48	12	16.8	71.42	99	98.0	20	15.1	12.2	53.5	75.5	1395
28	B	5	2 '14	109	62.3	57.15	19.0	.174	54.5	50	13	16.8	77.38	107.5	98.6	17.6	14.5	12.4	52	82.3	1247
29	G	5	12 '13	97.8	54.6	55.83	13.8	.141	52	53.17	11.7	15.7	74.52			16.4	13.8	11.8	49.5	84.1	1106
30	B	6	4 '13	118.5	62	52.57	23.5	.197	59.5	50.21	15.2	18.5	82.16	117	98.7	16.9	14.8	12.1	51	87.5	1208
31	G	5	10 '13	100	54.4	54.40	15.8	.158	56	56	14.5	15.8	91.77	96.5	96.5	16.5	13.7	11	49	83	1053
32	B	7	3 '12	107.3	58.4	54.52	20.6	.193	59	54.99	13.9	18.2	76.37	105.5	98.3	18.2	14.3	12.3	25.3	78.5	1157
33	G	5	7 '13	108.5	56.8	52.35	18.7	.172	60	55.29	13	17.5	74.28	106	97.6	17.1	14.1	12.2	49.5	82.4	1184
34	G	6	2 '13	107.5	63	58.6	17.2	.159	52	48.37	12.7	14.8	85.81	102	94.8	16.4	13.6	11.6	49	82.9	1082
35	B	5		109.5	60.5	55.25	16.7	.152	51.5	47.03	11.9	16.3	73.00	101	92.2	17.7	13.4	12.2	51	75.7	1169
36	G	6	2 '13	109	58.7	53.85	16.7	.153	52.5	48.08	12.6	18	70.00	105	96.3	18	13.4	12.6	51	74.4	1211
37	G															16.9	14.2	12.3	51.5	84	1187
38	B	5	'13	103.5	58.9	56.9	15.4	.148	52.5	50.82	11	17.9	61.45	101	97.5	17.1	14.1	12.2	51	82.4	1184
39	G	5	4 '14	104.5			14.4	.137	49	46.88	11.4	14.6	78.08	100	95.6	17	13.8	12.9	50.5	81.1	1208
40	B	5		101	58.1	57.52	17.6	.174						99	98.0	17.7	13.6	12.5	51.5	76.8	1203
41	G	5		106.5	57.2	53.7	17.6	.164						108	101.4	17.3	13.8	12.2	50.5	79.7	1175
42	G	5		106	60.5	57.7	19.7	.186	56.5	53.3	13.5	16.5	81.81	106	100	17.5	14.1	12.7	51	80.5	1239
43	G	5	4 '14	100.5	57	56.71	17.6	.174	59.5	58.2	13.5	17.8	76.40	100	99.5	17.6	13.7	12.8	51	77.8	1225
44	G	5	4 '14	104	61	58.65	16.7	.161	56	53.84	14	17	82.35	103	99.3	18.1	14.2	13.1	52	78.4	1306
45	G	5	8 '14	108.5			17.6	.161	55.5	51.15	12.5	17	73.52			18.3	13.8	13.3		76.6	1304
46	B	4		104			18.1	.174													
47	G	6	4 '12	108.5	61.5	56.68	18.1	.166	55.5	51.15	12.5	16.5	75.75	114	105	17.4	13.3	12.6	50.5	76.4	1176
48	B	5	5 '14	108.5	60.5	55.76	16.0	.147	52.5	48.38	12.5	15.3	81.69	104	95.8	17.1	13.5	13.3		78.9	1221
49	B	5																			
50	B	5	10 '13	103	60.5	58.73	19.2	.186	57	55.33	14	15.5	90.32	101	98.0	16.8	13		51.5	77.3	
51	B	5	1 '14	112	56.5	50.44	18.2	.163					·	110.5	98.6						
52	B	6	1 '13	109.5	61.3	55.98	18.5	.168						109	99.5	18.2	12.9			70.8	

for these organs to develop and function and therefore the more vigorous is the physique.

There are numbers of established norms for adults and numbers of development norms, both of absolute measurements and of ratios between measurements. Montessori has gathered together many in her book, and many have been established by investigators in our own country—Baldwin, Hrdlicka, Boas, Smedley, De Busk, Wood and others. By the use of these norms educators can pick out the children who vary from the established standards and who require special physical care and corrective gymnastics for satisfactory development.

In our anthropological examination we made the measurements which are generally considered important and computed the significant ratios and indexes. We also inspected the child generally and noted any unusual conditions. The measurements taken and indexes computed were:

1. Height (standing, sitting, index of stature)
2. Weight (weight-height index)
3. Chest (circumference, vital index)
4. Span of arm (span-height index)
5. Head (maximal length, maximal width, aural height, circumference, cephalic index, capacity or volume).

1. Height

The height (without shoes) and sitting height of each child are recorded in Table II. The height may be compared with the Baldwin norms* which are:

Boys		*Girls*	
5 yr.	41.8 in.	5 yr.	41.4 in.
5½ yr.	43.0 "	5½ yr.	42.2 "
6 yr.	45.4 "	6 yr.	44.3 "
7 yr.	47.8 "	7 yr.	46.8 "

The index of stature of each child recorded in Table II may be compared with the Montessori norms which are for five year-old children 59; for 6 year-old children 57; for 7 year-old children 56.

*Taken from Baldwin's *The Physical Growth of Children from Birth to Maturity*. Univ. of Iowa Studies in Child Welfare, Vol. 1, No. 1. In press.

2. Weight

The weight of each child recorded in Table II may be compared with the Baldwin norms which are:

Boys	*Girls*
5 yr. 37.6 lbs.	5 yr. 36.3 lbs.
5½ yr. 39.6 "	5½ yr. 38.1 "
6 yr. 45.2 "	6 yr. 42.6 "
7 yr. 50.6 "	7 yr. 48.0 "

Weight tells, however, very little about the size of the person, if we know nothing of his height. Eighty pounds is a good weight for a boy of 13 who measures 60 inches, but a poor weight for a boy of 13 who measures 63 inches. Considered in relation to each other, weight and height are indicative of the state of nutrition. Other things being equal, weight diminishes as malnutrition increases. This relation may conveniently be expressed by dividing the weight by the height to obtain the weight-height coefficient. In Table II is recorded this coefficient for each child. The amount of any child's deviation from the weight-height coefficient for his age can be obtained by comparison with the Baldwin norms, which are:

Boys	*Girls*
5 yr. .90	5 yr. .88
5½ yr. .92	5½ yr. .90
6 yr. .99	6 yr. .96
7 yr. 1.05	7 yr. 1.02

In order to secure the parents' interest in the children's condition, a meeting was called at which their attention was directed to the underweight and undernourishment discovered in the group. The Wood cards correlating ages, heights and weights were used as a convenient popular means for explaining to the parents the meaning of norms of development and were distributed in the hope that an attempt would be made in the homes to bring the children up to normal standard. By the Wood standards 30 of the 40 children are underweight for their age and height. Sixteen children are 10 or more per cent underweight. By Baldwin's Iowa norms, these children are relatively tall but underweight.

Insufficient food explains very few of these 30 cases; it explains two, possibly three, in all.

In examining the medical sheet for reasons other than food and housing, we find that children Nos. 4 and 5, each of whom lacked six pounds, both had adenoids, hypertrophied tonsils, enlarged glands, many carious teeth, flat foot and umbilical hernias. These little girls are twins. The mother takes good care of them and they have a comfortable home; but the parents, the father in particular, do not realize the importance of attending to such physical defects as are here summarized. The father objected to the examination by the physician. The children are bright mentally and would be good looking were they not forced by the condition of the pharynx to keep their mouths open most of the time. Child No. 6 also has a good home but we find that his vision is very poor and his teeth in bad condition. Child No. 7 is slightly deaf and has a number of carious teeth, but more important perhaps is the fact that the mother has been entirely unable to control the child and does not insist upon his eating the proper food. He eats what he chooses, when he chooses, and will eat nothing else. He is extremely nervous and overactive. More than all else this child needs discipline by one whose authority he would respect. Child No. 10 is a boy in a deplorable condition as a result of diseased tonsils and adenoids. He cannot breathe at all with closed mouth, there is a constant offensive discharge from the nose, the hearing is reduced in both ears and eight teeth are carious. Child No. 11 has enlarged glands, enlarged tonsils and very poor vision. Child 12 has adenoids, enlarged tonsils and cervical glands, defective vision, diminished hearing, heart murmur and rales. She has a good home, but is an only child, is uncontrolled and probably eats unwisely. Child No. 13 has enlarged glands, poor vision, heart murmur, scoliosis, lordosis, and needs circumcision. Child No. 14 has enlarged tonsils, carious teeth, defective vision and flat foot. Child No. 15 has defective vision, enlarged cervical glands, rales and heart murmur. This child very probably has insufficient food and poor home care. Child No. 18 has enlarged tonsils, adenoids and glands, and defective vision. Child No. 20 has defective vision. He is a very well cared for child from a well kept home. Child No. 21 has enlarged glands and adenoids. The home conditions are poor, and there is a possibil-

ity of insufficient nourishment. Child No. 22 has visual defects and heart murmur. The home is poor and ill-kept and there is a possibility of insufficient food. Child No. 23 has defective vision. Child No. 24 has but one defect, 12 carious teeth. The child is suffering much from toothache. The home is poor and badly kept. Child No. 26 has enlarged adenoids. The home is unusually good. Child No. 29 has enlarged adenoids and tonsils, is extremely nervous, but has, in general, been well cared for. Child No. 33 has enlarged adenoids, tonsils and glands, and flat foot, but is well cared for at home. Child No. 34 has enlarged tonsils, adenoids and glands, and carious teeth. Child No. 36 has enlarged tonsils and glands, adenoids, and defective vision. The home is good. Child No. 37 has carious teeth. No. 40 has carious teeth. No. 45 has enlarged glands and tonsils, and carious teeth. No. 47 has enlarged glands, defective vision, carious teeth and heart murmur. The home surroundings are poor. No. 48 has enlarged glands, carious teeth and defective vision. The family conditions show marked poverty. Nos. 51 and 52 have carious teeth; no medical examination was made. Thus every child who is underweight is shown to have one or more physical defects and in addition, 18 have a haemoglobin content under 80. Six of the underweight children were not given a haemoglobin test and five rated 80 or over.

3. Chest.

The relation between the circumference of the chest and the height furnishes another measure of the robustness of form. In a robust adult the chest circumference is close to one-half the height. At birth it is 8 to 10 cm. in excess of one-half the height, and at five about 4 or 5 cm. in excess of it (Montessori). The index, found by the formula $\frac{100 \times \text{Chest Circumference}}{\text{Height}}$ is called the Vital Index. In the adult it is 50, in the child of five it would normally be greater than 50. The vital index for each child in the group is recorded in Table II. Eighteen out of 43 children so measured have vital indices of less than 50, which means a decidedly small chest circumference; 22 have indices greater than 50, which is more nearly the expectation; and two have an index of 50, an adult proportion. One of these is a boy of 6 and one a boy of 5.

All but one of the children having a Vital Index of less than 50 are underweight.

The antero-posterior and transverse diameters of the chest (recorded in Table II) are significant not only in themselves but also in relation to each other. The ratio between them, the Chest Index, which is indicative of chest and lung development is calculated by the formula: $\frac{100 \times \text{Antero-posterior Diameter.}}{\text{Transverse Diameter}}$. At birth these diameters are nearly equal and the index varies from 90 to 100. The transverse diameter gradually increases over the antero-posterior until in adult life the average chest index is 75, with extremes of 65-85. The measures and indices for the group are given in Table II. They vary from 57.62 to 92.3 with an average of 76.77. The boy with the index of 57 is underweight and has scoliosis, heart murmur, and enlarged cervical glands. A girl with a chest index of 61 is also underweight and has enlarged cervical glands and tonsils, and lordosis. Another child with a chest index of 61 is much underweight and highly nervous. The other children all have chest indices within normal range.

4. Span of Arms.

The span of arms or distance between the tips of the middle fingers on each hand when the arms are stretched out horizontally is recorded in Table II. The span is interesting principally in the ratio to the height called the span-height index and calculated by the formula: $\frac{100 \times \text{Span of Arms.}}{\text{Height}}$ The indices found (Table II) vary from 91 to 105, the average being 97. The span was in most cases slightly less than the height, exceeding the height in the case of only four children. There was one index of exactly 100 and 22 indices of 98 and 99.

5. Head.

The exact significance of head measurements and of indices is still disputed ground in the field of anthropometry. Some investigators claim to have found that the circumference varies with the nutritional condition of the child. Others have found head size to be correlated with the intelligence of children. A third school, that of Karl Pearson, finds little relation between any head measurement and intellectual ability.

Head measurements must be considered in relation to the size of the body as a whole, the racial type of the individual and other vari-

ables. Apart from the question of their correlation with intelligence, it is of interest to study head measurements merely from the point of view of physical dvelopment. Accordingly, the maximal length and width of the head and the aural height were measured by means of a standard cephalometer and the circumference taken with an anthropometric tape. A tracing of the shape of each head was also taken, a band of soft lead being molded around the head, then placed upon a sheet of paper and its inner surface used as guide for a pencil tracing. This method is of course, not exact enough to secure slight anomalies of shape, but it does give, very satisfactorily for general inspection, the proportions and gross anomalies. The head conformitor, often used, which does record the exact shape of the head, is so heavy and so much like an instrument of torture that it is impossible to use it with such little children without frightening them. These measurements are recorded in Table II.

The circumference alone which is frequently given as indicative of head size, is rather misleading since it does not indicate to any degree the height of the vault of the cranium, which increases greatly as brain and head develop. The circumference has value when considered in relation to volume, but it is not the best index of volume. It varies in our children between 48 and 57 cm. In a collation of the findings of various investigators we find limits of 46 to 54.1 cm. for the ages five to seven inclusive. Our maximal circumference is that of a five year old girl, the child of Russian Jews. She has a head capacity of 1132 cu. cm. by the Lee formula discussed later in the *Study,* and is a brachycephalic. This is the only circumference which differs from the usual measurements.

The three diameters, breadth, length and aural height are given in Table II. The ratio between length and breadth, obtained by the formula $\frac{100 \text{ x Breadth}}{\text{Length}}$, is called the Cephalic Index. This index is, in children, more significant than the circumference because after the first two years of life the proportions of the cranium remain practically the same, while the circumference increases. This makes age norms necessary to judge of a circumference and unnecessary to judge of a cephalic index.

The cephalic index varies normally between 70 and 90. Within these limits there are three shapes of head: dolichocephalic, or the long head; brachycephalic, or the broad head; and the meso-

cephalic, or the intermediate form. If the cephalic index falls between 75.1 and 79.9 the shape is mesocephalic; if it falls between 70 and 75, the shape is dolichocephalic; if it falls between 80 and 86.9, the shape is brachycephalic; and if it is greater than 86.9, the shape is hyperbrachycephalic. These are figures limiting the types which are usually found in this country, but there are several other standards. An index less than 70 or greater than 90 indicates abnormality of some sort. The type of head is considered a racial characteristic. The people of Asia as a rule are brachycephalic, those of Africa dolichocephalic, those of Europe and America range from dolichocephalic through mesocephalic to to the extreme brachycephalic. The index is used as a basis for classification of human races and as a key to determine from which races a given people has originated.

The cephalic indices of our children, computed by the regular formula are presented in Table II. Among our children we found all three types of head. Five were dolichocephalic: children No. 2, 4, 36, 23 and 52; twenty were brachycephalic: children No. 1, 3, 9, 10, 12, 15, 17, 18, 20, 26, 28, 29, 30, 31, 33, 34, 37, 38, 39, 42; twenty-four were mesocephalic: children No. 5, 6, 7, 8, 11, 13, 14, 16, 19, 21, 22, 24, 25, 27, 32, 35, 40, 41, 43, 44, 45, 48, 50, and 54.

All of these children were born in the United States, but among the parents and grandparents we find the following nationalities represented: English, Irish, Swedish, Canadian, German, Dutch, Norwegian, Russian, Bohemian, Moravian and Danish. Among the dolichocephalic we find English and German ancestry; among the mesocephalics, English, Scotch, Irish, Canadian, German, Swedish, Norwegian, and Russian ancestry; and among the brachycephalics, English, Irish, German, Dutch, Swedish, Norwegian, Bohemian, Russian and Danish. All of the Bohemians are brachycephalic, one a hyper-brachycephalic; all but one of the Russians are brachycephalic, and his index is 79.7; the Norwegians, Danes and Dutch are represented only in the brachycephalic group; the the hyperbrachycephalic boy is extremely tall, large in all his proportions, very fair and blue eyed; his parents are Bohemians.

The cranial capacity of these children was computed by a formula of Alice Lee used by Dr. S. D. Porteus in a study of normal Australians and of feebleminded children in Vineland, N. J. The

formula is: (length — 11mm.) (breadth — 1mm.) (height — 11 mm.) $\times$ .000337 + 406 cu. cm. Table II shows the cranial capacity of each child in the group.

Cranial capacity increases with age up to a maximum which is set at different ages of adult life by different investigators. Like cephalic index it is dependent upon stature and race.

Porteus using the Lee formula and measuring normal children of seven, eight and nine years, gives limits of volume as 1160 and 1480 cu. cm., with a median of 1282. The limits of head volume with our group measured by the same methods, are 1053, Child No. 31, and 1395, Child No. 27, with a median of 1187. These two children whose head measurements are the extremes of our group are both five years old; their index of stature varies directly with head capacity (54.40--57.42) as also does their head circumference (49--53.5). The general intelligence of the child with minimum measurements is, if anything, a little more highly developed than that of the child with maximal measurements.

Just as the results of the medical examination are of greater diagnostic value when considered in relation to each other, so also are the anthropometric findings. In judging a chest development we learn more by referring to Index of Stature, Vital Index, and Chest Index than by referring to any one of these indices. By consulting Table II, we find that Child No. 7 has an Index Stature of 53.16, a Vital Index of 54.45 and a Chest Index of 89.40. We know by the first that his trunk is short in proportion to his legs, by the second, that the circumference of his chest is in good proportion to his height, and by the third that the chest is too round, retaining its infantile proportions. By referring to the medical record, Table I, we find that he has prominent scapulae and scoliosis. In this case the Vital Index alone gives no idea of the lack of development of the transverse diameter which the Chest Index and the note on the protruding scapulae supply. We naturally refer next to the lung record and find it clear. In judging of head development we learn more by referring to the Head Capacity, Cephalic Index and Circumference together than by referring to any one of them. Let us examine these measurements for Child No. 3. The head capacity is 1132 cu. cm. This is below the medium degree of brachycephaly. The circumference is 57, the largest circumference found in our class and several centi-

meters beyond standard norms for the age of the child. The circumference alone indicates a large head, the capacity contradicts this, the contrast between the two indicates a low vault of the cranium, and this we find is actually the case, the aural height being 11.1 cm., while the minimum height in all our children is 11 cm.

On account of the modifying effects of the various anthropometric data upon each other our findings are of much more practical use in forming a judgment of an individual child than they are in forming a judgment of the class as a group. The class averages for the various anthropometric measurements are therefore not presented.

IV. SPEECH EXAMINATION

The speech of 42 children in the group was tested, the following points being considered:

I. Posture of child in relation to speech.

II. Respiration
- a. Breath control
- b. Chest expansion
  Upper and lower chest inflated and deflated
- c. Type of breathing: Superior costal, inferior costal.

III. Voice
- a. Quality of tone: Resonant, unresonant
- b. Volume of tone: Loud, soft
- c. Inflection: Range of tone, monotony

IV. Speech
- a. Type of speech difficulty
- b. Specific record of consonants and consonant combinations giving difficulty
- c. Vowels slighted or non-resonant

The materials used were:

- I. Words containing all consonants in initial, middle and final position
- II. Words containing principal vowel sounds
- III. Selections for testing reading and articulation (School readers and story books or pictures)
- IV. Franz speech testing material Test No. 75141
- V. Set of alphabet blocks
- VI. Lewis Phonetic Cards (1915)
- VII. Tongue depressors and tongue applicators.

It was found impossible on the basis of the examination results to divide the class into two groups, one of which contained

children with perfect speech, and the other of which contained children with defective speech. In speech, as in other abilities, the transition is so gradual from normal performance to defective performance that it does not permit of an absolute dividing line. The division which seems most practical is that into two groups of children, one containing children who had no speech difficulties which could not be eradicated by regular classroom training, and one containing children who required special training for speech defects of a more serious nature. Of the 42 children examined, 32 fall into the first group, requiring no special form of speech training. Ten, however, need expert training for the correction of speech inaccuracies and negligencies, five of these ten being classified as defective speech cases. In one of the five a very marked and persistent infantile stammer exists. This child has great difficulty in making himself understood by anyone except a little brother of five years who not only understands him, but talks in the same way while conversing with him, though using normal articulation when talking to other people. The only time that this little boy, Child No. 1 of our series, talks freely, rapidly, and with ease and apparent enjoyment, is when he is playing with this little brother and has to make no effort to conform to the usual method of speech.

The specific speech difficulties found, with number of cases of each type, were:

Negligent lisping	6	cases
Organic lisping	2	"
Infantile speech	3	"
Monotony of tone	8	"
Faulty respiration	4	"
Nasality	4	"
Unresonant voice	7	"
Inaudibility	2	"
Negligent speech habits	4	"
Faulty articulation	7	"
Poor posture (affecting speech)	2	"
Total number of speech difficulties encountered	49	
Number of different types of speech disturbance	11	

In spite of the fact that in this one class of kindergarten children there are ten children who need instruction in speech from a person specially trained in the technique of speech correction,

the school system provided no teacher for this special type of work. If we assume that the need is as great in all first grades of the city as it is in this one under inspection, the failure to provide such instruction is a very serious omission. In the case of Child No. 1 it may result in absolute failure to progress in the grades.

V. MENTAL EXAMINATIONS

There are two facts about human beings which have an all-important bearing on educational practice. The first of these is a very great similarity of mental ability, the second is an equally great diversity of mental ability.

The first fact, the great similarity, has made it possible to develop intelligence scales, like the Binet tests, which in effect assert that average human beings all have a certain degree and kind of mental ability at 5 years of age, a certain other degree and kind of mental ability at 6, 7, 8, 9, 10, and 12 years of age, etc., as the age increases.

The second fact, the great individual diversity of mental ability, compels us to realize that among a group of, let us say, 20 children, each having the same level of mental development, we may have twenty different types of children, each one having his possibilities of greatest development and greatest success in a different direction from all the others. One child of the intelligence level of 10 years may have very good color perception and a vivid imagination and very poor application and reasoning ability; another child of the same intelligence level may be color blind and lacking in all invention and yet have well-developed capacity for sustained attention and good reasoning ability. Various combinations of abilities, disabilities, strengths and weaknesses, make a class of 20 children of about equal general intelligence a group of intensely individual characters, each presenting a different problem.

In our public schools, after the feeble-minded,—those permanently subnormal in general intelligence,—have been discovered and removed from the general classes, the problems of the teacher are not greatly simplified by a knowledge of each child's intelligence level. It is essential for the teacher to know much more than this; she must know for each child which mental abilities are most apt to yield the greatest rewards from cultivation and which

mental abilities it is vain to try to develop. She must know why this boy of good general intelligence does not learn to read, or does not learn to subtract. In order to obtain this knowledge, a mental analysis is necessary which will reveal the individual's mental strengths and weaknesses.

Many psychologists make such analyses, but a method of analysis combined with a method of presenting results equal in precision and clearness to the method used in presenting the results of an examination for general intelligence has never been developed. Rossolimo[17] used a method of expressing the results of such analysis which he called the psychological profile. His method contains a suggestion of one which perhaps combines the elements of clearness and precision for which we are looking. Rossolimo used a series of tests ranging over the various mental abilities, scored the results so obtained and presented them in graphic form. A perfect score for the test given for any mental ability was 10; if an individual made a score of 10 in visual memory, 7 in dispersed attention, 3 in color perception, etc., the graph would show a depression at the point representing dispersed attention and a still greater depression at the point representing color perception. The peaks in the graph would represent strengths of abilities, the depressions in the graphs, weaknesses. A graph consisting of a straight line would represent, according to Rossolimo, perfectly balanced mental abilities.

As a matter of fact, though it is possible to produce a graph showing just what Rossolimo attempted to show by his psychological profile, Rossolimo's graphs fail to do so. They fail because Rossolimo failed to equate the score values of his numerous tests. Each group of tests was scored by the same method, ten tests were given for each mental ability, 1 point accredited for each success, 10 being the perfect score. There is nothing in this procedure to suggest that a score of 10 in any one ability tested represents exactly the same strength of that ability as a score of 10 represents for each of the other abilities. It is easy to realize that a series of tests devised for one mental ability might demand a lesser degree of development of that ability in order to secure a perfect score than a series of tests devised for a second ability might demand of that second ability in order to secure a perfect score.

Claparède[5] recognized the inherent beauty of the profile method; he also realized that Rossolimo's failure to equate the scores for the several abilities completely destroyed the value of the profile as a record of the comparative strengths and weaknesses of an individual's mental ability. He, accordingly, suggested a very simple modification, or rather an amplification, of Rossolimo's profile which makes of it a true psychological profile, showing quite accurately the strengths and weaknesses in an individual's mental makeup.

Claparède proposed using a series of analytic tests, Rossolimo's or others, with a homogeneous group of individuals, let us say, 15 year old boys, arranging the results of each test in rank order and compiling from the rank orders of the various tests a percentile table for each to show what score in each test is made by the 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 percentile of the group. The actual scores made by any one percentile, say the 50 percentile, for the various tests might be quite different, but they would have the same percentile value for the group. One test might have a 90 percentile score of 40, another test a 90 percentile score of 80. The actual score for the latter test would be twice that for the first test, but its value as a performance compared with the performance on the other tests of the group would be exactly the same as that of the lower score for the first test. From the complete percentile table computed from the results of a series of tests given to a homogeneous group, we can learn just what scores the lowest tenth and the successively higher tenths of the group attained. We can compare with these findings an individual's score and learn at once the relation of his performance to that of the entire group, and can compare his score not only with the median score for the group, but with the score of each tenth of the group from lowest to highest.

If an individual made scores equal to the 90 percentile in all of the tests given, he would be uniformly strong mentally for the particular group of individuals (15 year old boys, 12 year old girls, congenitally blind adults, etc.) to which he belongs. If he made scores equal to the 50 percentile, he would be uniformly mediocre mentally. If he made scores equal to the 90 percentile in one test, the 70 percentile in another, and the 30 percentile in another, he would be of uneven ability, strong in some directions, weak in

others, and the differences disclosed would be a valuable guide for the wise teacher. The individual graph, or psychological profile, as Rossolimo calls it, according to this plan, will be made up from the percentile values of the scores, not from the actual scores, and the peaks and the depressions in this graph will actually represent strengths and weaknesses of achievement.

Rossolimo's profile, supplemented by Claparède's idea of basing the profile values on percentile values, has opened the way for clear, precise presentation of the results of a mental analysis, a presentation in a graph which will truly represent the psychological profile. We have adopted this method and have treated the results of a long series of analytic tests by the plan of Claparède, presenting the psychological profile for typical children in the group. (Charts III, IV, V, VI.)

The mental examination of each child included:

1. *General Intelligence Tests.* An examination and rating of the general intelligence by two methods:

The Binet Simon Intelligence Scale, 1911 revision[3]

The Stanford Revision of the Binet Simon Intelligence Scale[22]

2. *Analytic Tests.* A mental analysis made by the use of tests for:

(a) Perception:

(1) Grey	(4) Green	(7) Form
(2) Red	(5) Yellow	(8) Position
(3) Blue	(6) Length	(9) Weight

These are all tests of the perception of slight differences, the performance in each instance consisting of a comparison and matching.

(b) Immediate Memory for:

(10) Words	(13) Objects	(15) Position
(11) Sentences	(14) Forms	(16) Pictures
(12) Color		

(c) Attention

(17) Visual span

(18) Auditory span

(19) Simple attention

(20) Discriminative attention

(21) Simple attention

(22) Discriminative attention

(d) Active imagination

(23) Heilbronner

(24) Healy-Fernald Puzzle A

(25) Healy-Fernald Puzzle B

(e) Reasoning

(26) Judgment

(f) Psycho-motor ability

(27) Steadiness I, right hand

(28) Steadiness I, left hand

(29) Steadiness II, right hand

(30) Target, right hand

(31) Target, left hand

(32) Spirometer

(33) Dynamometer, right hand

(34) Dynamometer, left hand

(g) Learning ability (involving perception, attention, memory and motor habit formation)

(35) Healy-Fernald Puzzle A

(36) Healy-Fernald Puzzle B

(37) Wiring

(38) String games

(h) Suggestibility

(39) Judgment of length

(40) Judgment of weight

(41) Hallucination of smell

(42) Hallucination of taste

(43) Automatism, taps

(44) Automatism, eye—hand

3. *Complex Performance Tests.*

(45) Maxfield cube

(46) Seguin formboard

(47) Line reproduction

(48) Knox-Pintner cube

(49) Porteus maze

We thought it of interest to include in our mental examination several tests, the performance of which involves too many mental abilities to permit of their being included in the analytic series. They are all valuable in diagnosis, just because they do involve a complex mental activity and bring out characteristic temperamental reactions and fatigue reactions which the analytic tests

fail to do. These tests are five in number: the Maxfield cube test, the Seguin[21] formboard test, the line reproduction test, the Knox-Pintner[13] cube test, and the Porteus[14] maze test.

1. *General Intelligence Tests.*

Forty-five children were tested by the Binet Intelligence Scale[3] and also by the Stanford Revision of the Binet Scale.[22] In Table III are presented the scores in relation to the chronological age. The Symbol A indicates that the test age and chronological age are identical; numbers preceded by + indicate the number of years the test age exceeds the chronological age, and numbers preceded by — indicate the number of years the test age falls short of the chronological age. The same method of scoring is used for the Knox-Pintner cube test, and for the Porteus maze test, for both of which age norms have been established. It cannot be followed for the Healy A as the method of presentation is not comparable.

In the Binet-Simon 1911 series, 14 children scored at age, 18 children scored one year above age, 11 children scored two years above age, and two children scored one year below age. The mode thus shifts from the chronological age to one year higher, with 16 children attaining lower and 11 children attaining higher scores than the mode.

By the Stanford revision, 25 children scored at age, 16 children scored above, and four children below age. The mode is at age, but the distribution favors the excess age, scoring 16 to four. The Binet 1911 scale shows a better distribution around the mode, but the mode is one year in advance of the chronological age.

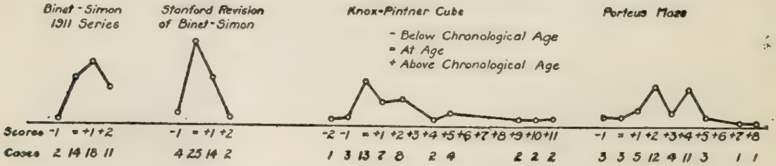


Chart I Distribution of Scores in Mental Age Tests

It is gratifying to note that only four children in this class grade by either scale below chronological age, and that no child is more than one year retarded. There is a possibility that one child in the class has subnormal intelligence, but he is handicapped by so many physical defects that their correction may result in greater progress than now seems probable.

2. *Analytic Tests.*

The scores obtained by each child for each of the 44 analytic tests are presented in Table III. The Mean and Mean Variation and the Probable Error and Probable Error of Mean are represented for each test. One test of imagination, two of attention, the Winch reasoning test, two learning tests (substitution method), and steadiness test II, left hand, were discarded as the result of the mathematical treatment of the results, the P. E. for each of these tests being greater than half the mean, and therefore invalidating the results. The individual scores for each of the 44 remaining tests were then arranged in rank order from the lowest to the highest. The lowest score for each test was used as the 0 score for the percentile table, the highest for the 100 percentile score; the lowest tenth of the series was considered in the 0 percentile; the lowest score above this lowest tenth of scores was used as the 10 percentile; the lowest score above the lowest two-tenths of scores for the 20 percentile, etc. From this percentile table of scores for each test (Table IV) the individual percentile ratings were obtained by translating individual absolute scores (Table III) into terms of percentiles. For instance, Child No. 3 made in test 15 a score of 28.56 (Table III). By looking at Table IV, one finds this is the score made by the 30 percentile of the group. Thirty, then, is the percentile rating for Child No. 3 in this test. The graphs or psychological profiles are plotted from the percentile ratings. Each profile represents one child's performance in the series of tests whose names are given at the top of the graph. A dot opposite the name of each test indicates the child's percentile rating in the test. The lower the dot on the graph the lower is this percentile rating and the poorer his performance. Typical profiles are shown for a number of children for whom descriptive sketches are also given in Section VI of this *Study.*

Our percentile values are computed from the results obtained from a small group of children. For a few of the tests the number was as low as 23, though for most of the tests it reached 39, 40 or more. Though the group was quite homogeneous the percentile values from such a small number could in no way be considered as norms. The percentiles were computed in the absence of norms for such young children, largely in order to make comparable the work of different children on the series of tests, and to realize fully the

possibilities of the profile method for mental analysis. Such psychological profiles as are here presented if based on accurate norms, cannot fail to reveal the mental strengths and weaknesses of the individuals they represent, and a series of such profiles will bring into prominence the differences in mental quality of the individuals represented. The value of such information to one choosing individuals from a group for a certain kind of employment or profession is very apparent.

a. *Perception*

Tests 1, 2, 3, 4, 5—Perception of Color and Brightness. The first group of tests was designed to measure the ability to perceive slight differences in color and brightness. The colors used were red, blue, green, and yellow. For each of these, five strips—tints 1 and 2, standard, and shades 1 and 2, Bradley Colors—were mounted, in the order named, on gray cards, and for each of these, five smaller gray cards were prepared on each of which was mounted a duplicate of one of the five colors on the large card. Similar materials were prepared, using five shades of Hering grays.

The tests were conducted as follows: the card containing the five reds was placed on the table before the child and the five smaller cards were placed nearer him. The experimenter pointed to the lightest tint, saying, "Find the red just like this." After the child had found it, the experimenter pointed to the next tint, giving the same directions and so proceeded until the five small cards had been placed. This procedure was repeated with blue, yellow, green and gray. It was found by preliminary experiments that more than five colors made the situation so complex that it ceased to be a true perception test for children of five years. The tests also ceased to be tests of perception if the child was asked to arrange the small cards as were the colors on the large card. Binet[3] called attention to a similar situation in his test which requires the arrangement of five boxes in order of weight, pointing out that the power to hold in mind the idea of serial order is involved as well as perception of slight difference in weight. The latter ability Binet placed at four years and the more complex one at ten years. For each of these tests, 20 was credited for each successful matching, the perfect score being 100. The group percentile score for the 39 children tested was high, 100 being the 40 percentile score for green and yellow and the

TABLE III (1)

				1	2	3	4	5	6	7	8	9	10	11
Child Number	Sex	Age	Binet Age	Gray	Red	Blue	Green	Yellow	Length	Form	Position	Weight	Words	Sentences
1	B	5	5	20	40	40	20	40	0	0	30	22.2	66.64	50.00
2	G	5	5+	60	66	40	100	100	16.66	66.64	50	66.6	66.64	62.50
3	G	5	6+	100	60	100	100	60	100.00	33.32	40	88.8	66.64	62.50
4	G	5	7	100	100	60	100	100	16.66	0	60	55.5	66.64	62.50
5	G	5	7+	60	100	60	100	60	33.32	0	40	44.4	66.64	75.00
6	B	5	7+	60	100	100	100	60	16.66	66.64	80	11.1	83.30	75.00
7	B	5	6	100	60	60	60	60			40	55.5	66.64	62.50
8	B	6	6+	60	60	100	100	100	33.32	66.64	80	55.5	83.30	87.50
9	G	5	6+	20	60	40	100	60	33.32	66.64	50	44.4	66.64	100.00
10	B	6	5+	60	40	60	100	60	16.66	0	40	100.0	66.64	100.00
11	G	5	6+	40	100	60	100	100	33.32	33.32	100	11.1	83.30	
12	G	5	6+	100	60	40	40	100	100.00	16.66	80	77.7	83.30	100.00
13	B	6	7+	20	60	20	100	100	66.64	0	80	22.2	83.30	50.00
14	G	6	6+	100	40	100	100	60	16.66	33.32	50	55.5	66.64	87.50
15	G	6	7+	40	100	40	60	60	100.00	33.32	40	22.2	83.30	75.00
16	G	5	6+	60	100	60	100	60	100.00	66.64			49.98	
17	G	5	7+	60	60	100	100	60	100.00	33.32	100	55.5	83.30	87.50
18	G	5	7	60	100	60	100	100	49.98	0	30	44.4	83.30	87.50
19	G	5	6+	60	100	60	60	60	100.00	49.98				
20	G	5	6+	100	60	100	100	100	49.98	0	30	44.4	49.98	62.50
21	B	6	6+	100	40	40	100	40	66.64	0	80	55.5	83.30	87.50
22	B	5	7+	60	100	100	100	100	16.66	16.66	50	44.4	100.00	75.00
23	B	5	7	100	20	100	100	60	100.00	16.66			83.30	100.00
24	G	6	6+	60	60	60	100	100	100.00	33.32	60	66.6	66.64	62.50
25	G	5	6+	40	100	100	100	100	49.98	49.98	20	44.4	100.00	100.00
26	G	5	5+	100	60	60	60	100	100.00	33.32	80	11.1	66.64	37.50
27	B	5	6+	40	40	40	100	100	100.00	33.32	100	44.4	83.30	100.00
28	B	5	5+	40	100	60	100	100	100.00	33.32	100	33.3	66.64	62.50
29	G	5	6											
30	B	6	7	100	20	40	100	100	66.64	16.66	40	55.5	100.00	100.00
31	G	5	6+										66.64	
32	B	7	6+	100	100	100	100	100	16.66	16.66	40	44.4	66.64	87.50
33	G	5	6+	60	60	100	60	60	66.64	49.98	50	44.4	83.30	87.50
34	G	6	6+	60	60	100	60	100	66.64	100.00	100	66.6	83.30	87.50
35	B	5	5+						49.98	0	60	77.7	66.64	
36	G	6	6+	60	40	60	60	60	66.64	33.32	50	55.5	66.64	100.00
37	G													
38	B	5	5+	40	100	40	40	100	33.32	66.64	50	77.7	66.64	50.00
39	G	5	7											100.00
40	B	5												
41	G	5												
42	G	5	5+	60	40	100	60	100	49.98	33.32	50	44.4	66.64	50.00
43	G	5	7+	60	100	40	60	100	33.32	16.66	50		83.30	87.50
44	G	5	7	60	60	60	100	60	100.00	33.32	100	66.6	83.30	75.00
45	G	5												
46	B	4												
47	G	6	6+										66.64	62.50
48	B	5	6+										83.30	50.00
49	B	5												
50	B	5	6+	100	60	60	100	60	100.00	66.64	80	55.5	83.30	100.00
51	B	5												
52	B	6	8+	100	60	100	100	100	66.64	0	100	44.4	100.00	75.00
No of cases				39	39	39	39	39	39	39	39	37	42	38
Failure														
Average				67.1	68.7	68.9	86.1	80.5	60.2	31.1	61.0	50	75.76	76.9
M. V.				21.8	22.2	22.2	19.1	19.9	26.7	12.4	18.7	15.7	10.71	15.8
P. E.				18.7	18.7	18.7	16.2	16.8	22.6	10.5	15.8	13.3	9.07	13.4
P. E. M.				2.9	3.0	3.0	2.5	2.7	3.6	1.6	2.61	2.1	1.39	2.18

TABLE III (2)

	12	13	14	15	16	17	18	19	20	20	21	22	28
Child Number	Colors	Objects	Forms	Position	Picture	Visual Span	Auditory Span	Attention, Simple	Attention, Discriminative	Diff. in Efficiency Indices	Attention, Simple	Attention, Discriminative	Heilbronner
1	0	28.56	20	14.28	50	0	0	2.50	1.53	.97	.72	.72	22
2	33.33	27.15	40	14.28	30	80	80	3.03	.79	2.24	.74	.72	26
3	100.00	28.56	40	28.56	80	80	40	5.00	1.80	3.20	.71	.75	18
4	0	14.28	40	57.12	40	100	60	5.00	2.50	2.50	—		15
5	33.33	28.56	20	42.84	100	80	60	2.27	1.63	.65			23
6	100.00	42.84	40	14.28	40	80	20	2.00	1.00	1.00	.64	.47	34
7					40		60	2.17	.81	1.36	.57	.52	29
8	100.00	42.84	40	42.84	40	60	60	4.34	1.50	2.84	.77	.67	32
9	100.00	28.56	40	57.12	80	60	60	4.00	1.28	2.72	1.00	.96	37
10	0	28.56	40	28.56	80	60	0	2.30	1.26	1.04	.48	.68	34
11	100.00	42.84	80	57.12	30	60	0	4.17	1.40	2.77	.66	.65	22
12	33.33	14.28	20	14.28	50	0	0	3.39	.50	2.89	.64	.72	29
13	66.66	28.56	40	28.56	40	0	0	2.50	1.10	1.40	.92	1.15	34
14	66.66	57.12	60	57.12	40	80	60	2.38	.95	1.43	.90	.91	34
15	100.00	42.84	40	42.84	50								33
16					40	0		1.81	1.38	.48	.83	.70	24
17	100.00	57.12	40	100.00	80	80	40	4.00	1.63	2.37	1.04	.85	36
18	33.33	42.84	40	28.56	40	60	100	5.00	1.50	3.50	.73	.50	22
19	66.66	57.12	40	42.84		60	40	2.50	2.50	0	.69	.55	31
20	66.66	57.12	40	28.56	70	0	0	5.00	1.20	3.80	.91	.68	35
21	66.66	42.84	20	57.12	30	80	40	5.00	2.20	2.80	.90	.83	38
22	33.33	74.40	60	75.68	60	60	80	3.39	1.20	2.19	.70	.71	28
23	100.00	42.84	60	28.56	100	80	60	3.33	1.69	1.64	.62	.48	24
24	100.00	42.84	80	28.56	80	80	40	3.03	1.20	1.83	.76	.74	27
25	66.66	100.00	60	42.84	100	80	60	4.17	1.30	2.87	.89	.67	34
26	66.66	28.56	60	28.56		0	0	2.38	1.60	.78	.79	.64	26
27	33.33	28.56	40	28.56	100	0	0	4.75	1.48	3.27	.72	.50	25
28	66.66	42.84	40	57.12	40	60	60	1.33	.83	.50	.83	.47	26
29					40								28
30	66.66	28.56	60	14.28	40	60	60	7.69	3.26	4.43	.99	.76	28
31	66.66							1.70	1.28	.42	.55	.55	
32	66.66	42.84	20	42.84	50	60	40	5.00	2.32	2.68	.55	.21	19
33	66.66	28.56	20	42.84	40	80	80	2.43	.97	1.46	.73	.51	29
34	66.66	57.12	40	14.28	40	60	60	3.70	1.25	2.45	.82	.58	29
35	66.66	28.56	20	0	40	0	0	3.81	2.00	1.81	.71	.36	36
36	100.00	42.84	40	42.84	60	60	60	2.94	1.81	1.13	.61	.57	17
37													
38	33.33	42.84	20	57.12	40	0	40	4.00	1.53	2.47	.30	.56	36
39					90	20							32
40													
41													
42	66.66	57.12	60	57.12	30	20	60	3.33	1.81	1.52	.75	.63	26
43	66.66	42.84	20	0	30	60	20	2.85	1.07	1.78	.63	.79	13
44	66.66	57.12	20	42.84	50	60	60	2.94	1.53	1.41	1.25	.38	20
45													
46													
47													
48						20	40						
49													
50	66.66	28.56	20	57.12	50	60	40	2.00	1.08	.92	.54	.22	24
51													
52	66.66	42.84	100	85.68	90	80	40	5.00	2.27	2.73	1.04	.50	29
No.	36	37	37	37	37	28	28	40	40	40	38	38	42
F.													
A.	65.7	42.45	41.60	40.91	55.5	68.57	52.1	3.44	1.50	2.0	.78	.62	28.2
M.V.	19.25	11.3	14.25	17.73	19.6	12	16.1	1.03	.38	.9	.14	.14	4.9
P.E.	16.26	9.55	12.04	14.99	16.6	10.1	13.3	.87	.32	.7	.11	.11	4.18
PEM	2.67	1.57	1.98	2.46	6.3	1.9	2.5	.12	.05	.1	.01	.01	.63

TABLE III (3)

	24	25	26	27	28	29	30	31	32	33	34	35	36
Child Number	Healy-A	Healy-B	Judgment	Steadiness 1 R	Steadiness 1 L	Steadiness 2 R	Target R	Target L	Spirometer	Dynamometer R	Dynamometer L	Healy-A	Healy-B
1	F	F	0	1	1	0	1	1	902	7.5	8.5	383.0	0
2	212	F	60	2	1	3.0	1	1	656	9	7	769.0	40
3	F	F	20	1	1	8.0	2	2	656	9	8	312.0	54
4	125	211	80	2	1	14.0	3	2	720	7	7		111
5	F	85	70	1	1	15.0	3	3	902	7	7	0	204
6	F	F	50	1	1	11.5	2	2	1066	10.5	9	222.0	222
7	F	F		2	1	8.0	3	0	492	7	10	0	66
8	75	145	30	3	2	11.0	4	3	1148	11	12	666.0	232
9	F	F	40	1	1	7.5	2	1	984	8	7	222.0	175
10	170	F	50	0	0	0	3	1	492	6	5	500.0	60
11	F	F	80	1	1	7.0	2	1	902	8	6	250.0	66
12	F	F	60	1	0	2.0			720	11	9	147.0	55
13	F	280	80	3	3	9.5	3	3	1312	13	12	0	178
14	F	F	60	1	1	3.0	3	2	738	9	8	178.0	66
15	100	60		2		15.0	2		401	8		500.0	178
16	80	90		1	1	7.0	3	3	820	10	9	119.0	166
17	F	115	50	1	1	6.0	3	2	656	6	6	500.0	217
18	F	142	20	1	2	7.0	2	3	720	6	5	666.0	161
19	F	F	50				3	2	401	5	5	250.0	4
20	56	F	80	2	2	9.5	3	2	656	6	5	83.3	74
21	123	110	50	1	1	10.0	2	3	720	7	6	125.0	83
22	F	56	70	1	0	7.0	1	1	1168	9.5	9.5	175.0	200
23	35	120	50	0	0	3.0	4	4				79.0	66
24	68	F	90	1	2	13.0	3	1	984	8	10	125.0	74
25	F	F	30	2	2	7.0	3	2	656	3	4	0	250
26	40	F		2	0	9.0	3	2	738	5	6	166.0	58
27	95	F	0	0	1	1.0	1	1	460	6	7	133.0	55
28	130	F	70	1	1	8.0	2	1	984	10	9	256.0	51
29	F			1	1	0	2	1	246	5	5	0	
30	120	F	90	1	1	9.5	2	2	574	12	7	357.0	200
31													
32	19	250	100	0	0	0	0	0	738	12	10	526.0	125
33	173	438	60	0	0	5.0	1	1	738	7	9	277.0	62
34	F	81	40	2	1	7.0	2	2	720	11	10	333.0	0
35	F	F	80	0	0	6.0	3	3	656	11	9	0	222
36	F	F	40	2	1	8.0	3	2	902	6	6	333.0	222
37													
38	F	F	60	2	2	0	2	1	246	6	5	0	69
39													
40				0	0	0	2	2					
41													
42	107	F	50	0	0	0	2	2	984	6	5	196.0	70
43	F	F	70	1	2	2.0	2	2	574	8	5	250.0	0
44	F	64	40	1	1	8.0	2	2	492	5	5	100.0	0
45													
46													
47				1	1	6.0	1	0					
48													
49				1	1	5.5	2	2					
50	F	109	60	1	0	5.0	2	1	656	6	8	166.0	58
51													
52	171	395	70	3	3	8.0	3	3	1394	10	8	500.0	200
No.	18	17	36	42	41	42	43	43	40	40	40	40	40
F.	23	23										7	5
A.	101	164	54.1	1.19	1	6.47	2.21	1.74	760	7.8	7.33	307.09	125
M.V.	41.9	33	20.2	.64	.56	3.29	.69	.77	204.01	1.9	1.41	152.82	65
P.E.	35.4	28	17.1	.53	.47	2.48	.58	.65	172.44	1.6	1.19	129.18	55
PEM.	8.35	7	2.8	.08	.07	.42	.08	.09	27.22	.25	.19	22.51	9.3

TABLE III (4)

	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Child Number	Wiring	String Games	Judgment-Length	Judgment-Weight	Hallucination-Smell	Hallucination-Taste	Automatism-Taps	Automatism-Eye Hand	Maxfield Cube	Form Board	Line Reproduction	Binet	Stanford	Knox-Pinter Cube	Porteus
1	50	0	0	F	F	+	S	N	50.00	51	27.5	A	−1	+1	−1
2	50	60	32	10	0	0	S	S	83.30	185	20.0	A	A	+5	+2
3	50	80	0	10	+	+	S	S	50.00	178	47.5	+1	+1	+2	+1
4	100	60	0	10	0	0	S	N	100.00	69	65.0	+2	+1	+2	+2
5	100	60	32	10	0	+	S	N	100.00	277	85.0	+2	+1	+9	A
6	50	0	32	10	0	+	S	S	33.32	256	55.0	+2	+1	+2	+4
7	50								33.32		20.0	+1	A	A	+2
8	50	60	25	0	+	+	S	S	83.30	333	55.0	A	A	−1	+5
9	100	80	32	10	+	+	S	S	66.64	172	70.0	+1	A	+1	A
10	0	20	23	10	0	0	S	S	16.66	119	17.5	−1	−1	−1	+1
11	50	20	32	10	+	0	S	S	16.66	76	42.5	+1	A	A	+2
12	0	40	32	10	+	0	S	S	66.64	83	25.0	+1	A	A	+2
13	50	40	32	10	0	0	S	N	66.64	200	70.0	+1	A	−1	+4
14	100	40	32	10	+	+	S	S	33.32	78	70.0	A	A	A	+4
15	50						S	S	83.30	238	87.5	A	A	A	+2
16		80							66.64	61		+1	A	+5	+4
17	100	80	32	10	0	0	S	N	83.30	222	90.0	+2	+2	+9	+5
18	100	20	18	10	+	0	S	N	300.00	151	55.0	+2	+1	+1	+4
19	50		32	10	+	+	S	S	33.32	51	60.0	+1	A	+5	+3
20	100	40	32	F	+	+	S	S	83.30	192	45.0	+1	A	+1	+4
21	100	40	32	10	+	0	S	S	83.30	274	85.0	A	A	+4	+7
22	100	60	32	10	0	0	S	S	100.00	263	60.0	+2	+2	+1	+8
23		20	32	10	+	0	S	S	100.00	270		+2	+1	+10	+4
24	100	20	32	10	+	0	S	N	83.30	333	37.5	A	A	A	+3
25	0	20	32	10	0	0	S	S	66.64	217	35.0	A	A	+5	+1
26	100	40	32	10	+	+	S	S	33.32	71	25.0	+1	+1	A	+1
27	50	40	32	10	+	0	S	N	33.32	227	40.0	+1	A	+1	+2
28	0	20	0	F	+	0	S	N	66.64	98	55.0	A	A	A	+5
29	0								16.66		12.5	+1	A	A	A
30	100	40	32	10	0	0	S	N	66.64	87	70.0	+1	A	+10	+3
31	50								83.30	175		+1	+1		
32	100	80	32	10	+	0	S	N	50.00	80	12.5	−1	−1	−2	−1
33	100	60	32	10	0	+	S	N	83.30	166	27.5	+1	+1	+2	+2
34	50	20	32	10	+	+	S	S	83.30	69	85.0	A	A	A	+3
35	100	20	32	10	+	+	S	N	16.66		15.0	A	A	A	−1
36	100	20	32	10	+	+	S	S	100.00	142	65.0	A	−1	A	+2
37															
38	100	40	32	10	+	+	S	S	100.00	66	27.5	A	A	+2	+4
39			17	10					66.64			+2	+1	+2	+2
40	50														
41															
42	100	20	32	10	0	0	S	N	33.32	75	50.0	A	A	+2	+2
43	50	0	32	10	0	0	S	N	33.32	156	30.0	+2	+1	A	+2
44	100	40	28	10	0	0	S	N	100.00	45	60.0	+2	+1	+11	+1
45															
46															
47	100								100.00			+1	+1	+11	+4
48												+1	A	+1	—
49	0														
50	100	40	32	10	+	0	S	N	66.64	175	30.0	+1	A	+2	+4
51									100.00						
52	100	80	32	10	0	0	S	N	100.00	200	70.0	+2	+1	+4	+4
No.	38	36	38	38					45	42	38				
F.	4	3	3	3						3					
A.	70	41.8	29						67.02	158	48.7				
M.V.	22	18.7	4.5						23.35	70.9	19.8				
P.E.	19.3	15.36	3.8						19.74	59.93	16.7				
PEM.	2.8	2.67	.64						2.94	9.6	2.6				

TABLE IV

Percentiles	Gray	Red	Blue	Green	Yellow	Lines	Form	Position	Weight	Words	Sentences	Color	Objects	Forms	Position	Pictures	Visual Span	Auditory Span	Attention Simple	Attention Discrim.	Attention Simple	Attention Discrim.	Heilbronner	Healy–A
100	100	100	100	100	100	100	100	100	88.8	100	100	100	100	100	100	100	100	100	7.69	0	1.30	1.15	42	19
90	100	100	100	100	100	100	66.64	100	77.7	88.30	100	100	57.12	60	57.12	90	80	80	5.00	.50	1.04	.85	36	35
80	100	100	100	100	100	100	49.98	80	66.6	88.30	100	100	57.12	60	57.12	80	80	60	4.75	1.00	.91	.75	34	56
70	100	100	100	100	100	100	33.32	80	55.5	88.30	87.50	33.33	42.84	40	57.12	60	80	60	4.00	1.40	.83	.71	32	80
60	60	60	60	100	100	66.44	33.32	60	55.5	88.30	87.50	33.33	42.84	40	42.84	50	80	60	3.40	1.50	.77	.68	29	95
50	60	60	60	100	100	66.44	33.32	50	55.5	66.64	75	16.66	42.84	40	42.84	40	60	60	3.33	1.83	.73	.64	28	107
40	60	60	60	100	100	49.98	16.66	50	44.4	66.64	75	16.66	42.84	40	42.84	40	60	40	2.94	2.45	.72	.57	26	120
30	60	60	40	60	60	33.32	16.66	50	44.4	66.64	62.50	16.66	28.50	40	28.56	40	60	40	2.50	2.72	.70	.52	25	125
20	40	40	40	60	60	16.66	0	40	44.4	66.64	62.50	16.66	28.50	20	14.28	40	60	40	2.37	2.84	.63	.50	22	170
10	40	40	40	60	60	16.66	0	30	22.2	66.64	50.00	16.66	28.50	20	14.28	30	60	20	2.00	3.27	.55	.38	20	173
0	20	20	20	20	40	0	0	20	11.1	49.98	37.50	0	14.28	20	0	30	20	0	1.33	6.40	.48	.21	13	212
No. C.	39	39	39	39	39	39	39	39	37	42	38	36	37	37	37	40	28	28	40	40	38	38	42	18

Healy–B	Judgment	Steadiness 1–R	Steadiness 1–L	Steadiness 2–R	Target–R	Target–L	Spirometer	Grip–R	Grip–L	Healy—A	Healy–B	Wiring	String Game	Suggestion Length	Suggestion Weight	Suggestion Odor	Suggestion Taste	Automatism 1.	Automatism 2	Maxfield Cube	Form Board	Line Reproduc.	Binet+	Stanford Revision+	Knox-Pintner Cube+	Porteus Maze+
56	100	3	3	15	4	4	1394	13	12	769	350	100	80	0	0	—	—	+	—	100	333	90	+2	+2	+11	+8
60	80	2	2	11	3	3	1148	11	10	526	222	100	80	18	10	—	—	+	—	100	270	85	+2	+1	+11	+5
81	80	2	2	9.5	3	3	984	10.5	9.5	500	200	100	60	32	10	—	—	+	—	100	227	70	+2	+1	+5	+4
90	70	2	1	9	3	2	902	9.5	9	357	178	100	60	32	10	—	—	+	—	83.30	200	60	+1	+1	+4	+4
109	60	2	1	8	3	2	738	8	8	312	161	100	40	32	10	—	—	+	—	83.30	175	55	+1	=	+2	+3
115	60	1	1	7	2	2	720	8	7	250	83	100	40	32	10	+	—	+	+	66.64	156	47.5	+1	=	+1	+2
142	50	1	1	6	2	2	656	7	7	196	69	50	40	32	10	+	—	+	+	66.64	119	40	+1	=	+1	+2
195	40	1	1	5	2	1	656	6	6	166	66	50	40	32	10	+	+	+	+	50	80	30	=	=	=	+2
250	40	1	0	2	2	1	574	6	5	147	58	50	20	32	10	+	+	+	+	33.32	71	25	=	=	=	+1
395	20	0	0	0	1	0	410	5	5	125	55	00	20	32	10	+	+	+	+	33.32	61	17.5	=	=	=	=
438	0	0	0	0	0	0	246	3	4	79	40	00	0	32	10	+	+	+	+	16.66	45	13.5	—1	—1	—2	—1
17	36	42	41	42	43	43	40	40	39	33	35	40	33	35	35	36	35	38	38	45	39	38	45	45	44	43

+years excess or deficit in relation to chronological age.

70 percentile score for red, blue, and gray. In no case was there a complete failure though the 0 percentile was 20 for red, blue, green, and gray. The individual scores and percentile scores are presented in Tables III and IV.

Test No. 6. Perception of Differences in Length. The method of perception of small differences was again used. A gray card 2½ by 4½ inches had drawn on it six vertical lines ⅜ of an inch apart, the shortest 1 inch long and the others increasing regularly in length by ⅛ of an inch. The child was given six small gray cards 1½ inches wide, on each of which was drawn a line similar to one of the six lines on the large card. The procedure was exactly that used in the color perception test. The examiner pointed to the shortest line on the card containing the six lines and then to the other lines in order, saying each time, ''Find the line just like this.''

A credit of 16.6 was given for each line matched correctly, 100 constituting a perfect score. Thirty-nine children were again tested, the 70 percentile group making a perfect score, the 50 percentile a score of 66.44 and the 0 percentile 0. The average score was 60.2, M. V. 26.7, P. E. 22.6. The group did not succeed so well here as with the color perception tests. (Tables III, IV).

Test No. 7. Perception of Differences in Form. Again the method of perception of small differences was used. A series of six gray figures was mounted on black cardboard. The first figure was a 1½ inch square. The base lines and heights of all figures were 1½ inches but the upper side diminished by 1/16 of an inch in each succeeding figure, both ends of the line being shortened by 1/32 of an inch. Similar figures were drawn on small cards, one figure on each card. These were given to the child and he was asked, as in the preceding tests, to ''find one like this'' as the examiner pointed successively to the mounted figures on the large card.

Credit of 16.6 was given for each correct matching. Thirty-nine children were tested, and the perfect score of 100 was reached only by the 100 percentile of the group; the 50 percentile scored 33.32 and the 20 percentile score was 0. The average score was 31.19, M. V. 12.4, P. E. 10.5. The children found greater difficulties in this test than in any of the preceding tests. (Tables III, IV,).

Test No. 8. Perception of Position .The materials were again five lines. These were two inches in length, drawn above a base line on a strip of gray cardboard 12½ inches long. The first line was hori-

zontal and parallel with the base line; the second was tilted up at the left end; the third, fourth and fifth lines were increasingly tilted. Five lines similarly placed were drawn on smaller cards. As in the other perception tests, the child was asked to find a line like each in turn as it was pointed out. The test was repeated with lines in the vertical direction.

A credit of 10 for each matching was given. Thirty-nine children were tested, the 90 percentile making a perfect score; the 50 percentile, 50, and the 0 percentile 20. The average score was 61, M. V. 18.7, P. E. 15.8. (Tables III, IV).

Test No. 9 Perception of Weight. This was quite a difficult performance for the little ones. Tin pill boxes were used which were weighted with shot. One, weighing ten grams, was used as a standard weight and nine others compared with it; four of these were heavier, increasing by amounts of two grams each; four were lighter, decreasing by amounts of two grams each; and one weighed the same as the standard. The child was given the standard weight in one hand and then handed another and asked, "Is this heavier, lighter or just the same?" When the opinion was given, the child was allowed to place one box on one pan of a scale and one on the other pan to see whether his judgment was correct. Without this procedure it was hard to hold the children's attention to the test; with it, they greatly enjoyed the game. There were nine judgments, 11.1 being the credit for each. No one child attained a perfect score and only one of the 37 children tested reached the 100 percentile, 88.8. The 50 percentile score was 55.5 and the 0 percentile score 11.1. The average score was 50, M. V. 15. 7, P. E. 13.3. (Tables III, IV,).

b. *Memory*

The tests for memory were six in number. They tested the immediate memory span for number words, for words connected in sentence form, for colors, for familiar objects, for geometric forms, for position, and for pictured objects. It was necessary to confine the word memory tests to the oral field as the children had not yet learned to read.

Test No. 10. Memory for Words. The span for number words was tested as follows. The examiner said to the child, "I am going to say some words and after I finish I want you to say just what I have said." Then she pronounced two numbers, and if the child succeed-

ed in repeating them, she tried a series of three, then of four and so on, increasing each time by one until the child made an error in repeating. He was then given two more chances to repeat a list of equal length and if he succeeded, a list longer by one word was used. When the child failed three successive times to repeat lists of equal length, his span was placed at the longest list which he had succeeded in repeating. As lists containing six numbers were repeated by four children in the group and as a span for five numbers is shown by Binet[3] to be an eight year performance and a span of three, a four year performance, six was considered a perfect span for our children and a score of 100 was assigned to it, 16.66 being given for each number repeated correctly in the longest series repeated perfectly. Forty-two children were tested. The 100 percentile made a perfect score; the 60, 70, 80 and 90 percentile made a score of 83.3 (span 5); the 0 percentile score was 49.9 (span 3) the 50 percentile score was 66.6 (span 4). The average score was 75.7 M. V. 10.7, P. E. 9. (Tables III, IV).

Test No. 11. Memory for Sentences. For measuring the memory span for words combined in sentence form the group of sentences prepared by Binet was used. The highest achievement of the group was shared by eight children, who repeated sentences containing sixteen words. A score of 100 was assigned to this performance and 6.25 given for each word in the longest sentence repeated. Thirty-eight children were tested, the 80, 90 and 100 percentiles making a perfect score; the 0 percentile score was 37.5 and the 50 percentile score was 75. The average score for the group was 76.9; M. V. 15.8; P. E. 13.4 (Tables III, IV).

Test No. 12. Color Memory. For testing color memory, the materials used were twelve white cards, 3 by 5 inches, in the center of each of which a 1 inch square of colored paper was pasted, and a card 5 by 6 inches, on which twelve similar squares were pasted. Two of the small cards were shown to the child, who was told to look at them well because he would be asked to pick out these colors on a card containing these and other colors. The small cards were removed and the large one substituted and the child asked to point out the colors which he had just seen. If he failed, he was given two more chances with two different colors each time. If he succeeded in one of the three trials, the procedure was repeated with three and with four colors until the child failed to recognize three series each con-

taining the same number of colors. His span was taken to be the largest number of colors he remembered in one of three trials.

Thirty-six children were tested and three proved to be the largest span reached. One hundred was assigned as the perfect score for 3 and 33.3 was accredited for each color remembered in the longest series correctly matched. The 80, 90, and 100 percentiles attained a score of 100; the 0 percentile failed entirely; the 50 percentile made a score of 16.66 (span 2). The average was 65.7; M. V. 19.25; P. E. 16.26. (Tables III, IV).

Test No. 13. Memory for Familiar Objects. For testing memory for familiar objects, the following objects were used: book, twine, pencil, envelope, key, black-board eraser, box, pocket-book, nickel, ring, bag, and handkerchief. The objects were all placed in a large pasteboard box. Groups of the objects were placed on the lid of the box, shown to the child, then replaced in the box while he waited in another part of the room. He was then asked to pick those he had seen from the complete group. The procedure followed was identical with that used for the color memory test. The child was given three chances with each group containing a given number of objects until he failed in three successive trials with the given number of objects, one success in any group constituting success with that group.

Thirty-seven children were tested. Seven objects being the greatest number remembered by any one child, a score of 100 was assigned to the span of 7 and 14.28 was accredited for each object remembered in the maximal span attained. The perfect score was made only by the 100 percentile, the 80 and 90 percentile scores being 57.12 (span 4), the 0 percentile score being 14.28 (span 1) and the 50 percentile score being 42.84 (span 3). The average was 42.4, M. V. 11.3, P. E. 9.5. (Tables III, IV).

Test No. 14. Memory for Form. Materials used in testing memory for form were chosen from the Bradley box of forms. They consisted of a sphere, spheroid, cube, ovoid, two cylinders, two pyramids, circle, cone, square and prism. The procedure was exactly the same as that used in testing memory for objects. Thirty-seven children were tested; five was the greatest number of forms remembered; 100 was therefore assigned as the score for a span of 5 forms, and 20 for each form remembered in the maximal score attained. The perfect score was made by only one child. The 80 and 90 percentiles made scores of 60, (span 4), the 0 percentles a score of 20 (span 1) and

the 50 percentile a score of 40 (span 2). The average was 41.6, M. V. 14.25, P. E. 12.

Test No. 15. Memory for Position. The test for memory of position is one used by Rossolimo.[17] Ten white cards, 3 inches square, were used. These were ruled in nine 1 inch squares. On card 1 a black dot was placed in the center of the lower right square; on card 2, a black dot was placed in the center of the middle left square; on card 3, two black dots were placed, one in center of middle right and one in center of lower left squares; on card 4, black dots were placed in center of upper center, middle right, and lower left squares; on card 5, black dots were placed in center of upper left, upper center, and lower right squares; on card 6, black dots were placed in center of upper left, upper right and lower left squares; on card 7, black dots were placed in center of middle left and middle center, upper right and lower right squares; on card 8, dots were placed in center of middle left, lower left, upper center and middle right squares; on card 9, dots were placed in upper left, middle center, middle right, lower right and lower center squares; on card 10, dots were placed in center of upper left, middle left, upper center, lower center and lower right squares. Squares of paper ruled exactly like the cards but not containing the dots were given each child. Card 1 was shown to him and he was told to remember where the dot was because he would be asked to draw it on one of the papers. The card was removed and the child drew the dot on the ruled sheet. This procedure was repeated until all cards were shown.

Thirty-seven children were tested. No children succeeded in remembering the positions of the dots on cards 8, 9, and 10. Therefore the score of 100 was given for success with the first 7 cards and 14.28 assigned for each card successfully reproduced. Only one child made a perfect score; the 70. 80, and 90 percentile scores were 57.1 (four cards) the 0 percentile was 0 and the 50 percentile was 42.8 (three cards). The average score for the group was 40.9, M. V. 17.7, P. E. 14.9. (Tables III, IV.)

Test No. 16. Memory for Pictured Objects. Material for testing memory for pictured objects was found ready-made in a game consisting of 72 little colored pictures of familiar objects such as a horse, cat, kite, doll, table, etc. and 6 cards, on which are duplicated the smaller pictures, 12 small ones on each large card. The proced-

ure used is the same as that described in tests for color, object and form memory, the small pictures being shown in groups of two, four, etc. and the child being required to point to the same pictures on a card which was exposed as soon as the small pictures were removed. Three successive failures in a group consisting of a given number of pictures constituted a failure and the span was recorded as the largest number of objects recognized. Forty children were tested; four children recognized each object in a group of ten. This was the best record and a score of 100 was assigned to it, 10 being given for each picture in the largest group recognized. The 100 percentile made a perfect score (span 10), the 0 percentile, a score of 30 (span 3), the 50 percentile a score of 40 (span 4). The average score for the group was 55.5, M. V. 19.6 and P. E. 16.6.

c. *Attention*

The tests selected to examine attention were nine in number: a test of visual span, a test of auditory span, two designed to test simple attention, two to test discriminative attention, two to test disparate attention, and one to test the scope of attention. It was found necessary to omit the last three tests mentioned from our group results, as the probable errors for all three tests were too large.

Tests No. 17 and 18. Visual and Auditory Span. The test for visual span was very simple. Parallel lines were drawn on cards, two on one card, three on another, four, five and six on still others. A card was exposed for an instant; it was then removed and the child asked how many lines there were on the card. This was continued until his maximal span was ascertained.

The auditory span was judged in a similar way, a series of taps with a pencil on the desk being the stimulus. Twenty-eight children took these tests. Five was the largest group of lines and of taps perceived by any child. A score of 100 was assigned to this performance, and 20 given for each number in the highest span attained. For both tests the 100 percentile score is 100 and the 50 percentile score is 60; the 0 score for visual span is 20 and for auditory span 0. The average for visual span is 68.57, M. V. 12, P. E. 10.1; the average for auditory span is 52.1, M. V. 16.1, P. E. 13.3.

Tests No. 19, 20, 21 and 22. Simple and Discriminative Attention. Two tests for discriminative attention were used; the first was a cancellation test. For it the Woodworth and Wells[24] substitution

test sheet, geometric forms, was used, the child being told to cross out all the squares. This sheet was used rather than the cancellation sheets made up of letters or numbers because the figures are larger and the eye strain, which is considerable in the letter and number tests, is eliminated.

As two elements of performance, accuracy and rapidity, enter into the discrimination test, the score is expressed in terms of an index of efficiency obtained by use of the formula

$$\frac{\frac{C - W}{C + O} \times 100}{T}$$

C representing the number of figures crossed, W the number of figures wrongly crossed, O the number of figures omitted, and T the time consumed in performance.

As for many children of five years the act of crossing out, apart from any purpose in so doing, claims much attention and care, and as at this age the degree of skill in crossing out varies much from child to child, the efficiency index for the discriminative attention test depends not only upon the degree of discriminative attention attained, but also upon manual dexterity. On this account the efficiency index attained by one child is hardly comparable with that attained by another, as one does not know the relative values of the manual dexterity element for the two children. In order to reach a truer expression of ability in discriminative attention, the examiner introduced another test which calls for the same manual skill, but for no discrimination. Twenty squares (there are twenty squares on the Woodworth and Wells sheet) were drawn on paper and the child asked to cross them out, the time being recorded. This test was given in every case before the discrimination test. The index of efficiency was obtained by the formula given above. As errors and omissions were few, the index was in most cases

$$\frac{\frac{20}{20} \times 100}{T}.$$

There were several exceptions, however. A comparison of the efficiency index attained by any child in the cross-out test with the index attained by the same child in the discrimination test will show a lowering of the efficiency index, due to the added element of discrimination, and this difference in efficiency indices is a truer expression of efficiency in discrimination than the efficiency index for

that test, because it expresses the loss of value in efficiency index due to the added task of discrimination. The greater the loss in the efficiency index, the less is the efficiency of discriminative attention. In the case of one child only was there no difference between the two indices. She crossed out all the squares in both the tests and in just the same time, 40 seconds. The practice in crossing out in the first test may have compensated for discrimination time in the second test. In Table III the indices for both tests and the differences in the two indices are presented. In the individual profiles only the percentile rank for the index of the simple cross-out test and the percentile rank of the difference between the two indices are represented. Forty children were tested. The 100 percentile score for the cross-out was 7.69, the 50 percentile score was 3.33, and the 0 percentile score 1.33. The average was 3.44, M. V. 1.03, P. E. 0.87. The 100 percentile scores for the discrimination differences was 0, the 50 percentile 1.83, the 0 percentile 6.40. The average was 2.0, M. V. 0.9, P. E. 0.7.

Two other comparison tests in simple and discriminative attention were taken from Rossolimo.[17] These were perforation tests. In a white card, 8½ by 4 inches, were punched 102 holes in a regular pattern. A very heavy piece of felt was placed on the table before the child. It was covered by a piece of paper and on top of the paper was placed a perforated card. The child was given a stiletto and told to punch a hole in the paper through each hole in the card. The procedure was illustrated for the child and he was shown that the pattern on the card was reproduced on the paper. His performance was timed. This test was followed by another, similar to this but with a greater number of holes, and the child was asked to punch only those holes which were encircled by a line drawn with ink. (There were actually 102 of these). The first test is designed to test simple attention, the second to test discriminative attention. A slight change was made in Rossolimo's test for the sake of uniformity. Rossolimo simply uses the reverse side of card one for test two, encircling 62 of the holes on the reverse side. It was thought better for the sake of comparison of results to require the child to punch the same number of holes, and therefore a second card was prepared, bearing a design, in which the unit figure of the first card was used a greater number of times.

Efficiency indices were calculated for both of these perforation

tests by the use of the formula used in treating the cancellation tests. Thirty-eight children were tested. In the simple perforation test the 100 percentile score was 1.3, the 0 percentile score 0.48, and the 50 percentile score 0.73. The average was 0.78, M. V. 0.14, P. E. 0.11. In the discrimination test the 100 percentile was 1.15, the 0 percentile score 0.21, the 50 percentile 0.64. The average was 0.62, M. V. 0.14, P. E. 0.11. The difference in the efficiency indices for these two tests were also calculated, and it was found that the 80 percentile lost nothing in effiiciency index through the added complication of discrimination, and that the 90 and 100 percentile gained in efficiency. In no case did the difference exceed 0.87. These results indicate that the increase in ease of punching due to punching 102 holes increases the efficiency in the second test enough in many cases entirely, and in all cases partially, to compensate for the added complication of the task. The differences in the efficiency indices, therefore, are not so good an indication of the power of discriminative attention as are the indices of the discrimination test itself, and these are therefore given in both tables and profiles. (Tables III, IV.)

Disparate Attention. The two tests of Rossolimo[17], used to study disparate attention, were found unsuitable for such young subjects.

(d) *Imagination.* For testing imagination one test was used to study the passive form, the Heilbronner [11] unfinished picture test, and four tests to study the active, creative form. These were (1) the invention of sentences containing two different words; (2) the arrangement of a picture story, both of which proved unsuccessful for the purposes of this experiment, and (3) (4), the Healy Fernald Puzzles A and B.

Test No. 23. Heilbronner. The material for this test consists of 13 series of cards. On all but one card of each series are drawings, in varying degrees of incompleteness, of some familiar object, and on one card is the completed representation. The cards of each series are shown to the child in the order of increasing completeness until the object is correctly named. The objects pictured are: windmill and telephone (seven drawings each); clock, graphophone, butterfly, fireplace and thermometer (six drawings each); pencil (five drawings); book, broom, and lamp (four drawings each), pen (three drawings).

The fireplace and thermometer series were discarded as the com-

pleted drawing of the fireplace scarcely suggested one, and a thermometer was not familiar to the group. Each of the 11 remaining series was scored according to the number of pictures in each. A child who named on the first card the object pictured in seven suggestions, received a score of 7; a child who failed to name the same object until the sixth card, received a score of 2, losing one for each drawing on which he failed to recognize the object. If he failed on all seven cards he lost seven points. As two series contained seven drawings each, four series six drawings each, one series five drawings, three series four drawings each, and one series three drawings, the maximum score was 58.

Forty-two children were tested, making an average of 28.2, M. V. 4.9, P. E. 4.18. The 100 percentile score is 42, the 50 percentile score 28, and the 0 percentile 13. (Tables III, IV).

Test No. 24, Healy-Fernald Puzzle A. The Healy-Fernald Puzzle A[10] is a well-known test of the formboard type. Five small rectangles of varying size must be fitted into a rectangular space. The test is scored by recording the number of seconds used by the child in solving the puzzle. Ten minutes was the limit of time allowed. Forty-one children were tested; 23 failed to succeed in ten minutes. The 18 who succeeded made an average time of 101 seconds, M. V. 41.9, P. E. 35.4. The 100 percentile score was 19, the 50 percentile 107, and the 0 percentile 212. (Table III, IV.)

Test No. 25, Healy-Fernald Puzzle B. The Healy-Fernald Puzzle B[10] is another well-known formboard puzzle. This was also scored by recording the time consumed in solving, and ten minutes was the limit allowed. Forty children were tested, and again 23 failed to solve the puzzle in the ten minute limit. For the 17 who succeeded, the average time was 164 seconds, M. V. 32., P. E. 28. The 100 percentile score was 56, the 50 percentile 115, and the 0 percentile 438. The achievement in Puzzle A is thus quite superior to the achievment in Puzzle B. (Tables III, IV).

(e) *Reasoning.* Three tests of reasoning power were tried, only one proving valuable for such young children. In the first test the child was given a simple figure and told to trace it with his pencil, never lifting the pencil, or never drawing over the line twice. This was done successfully by only seven of the 36 children tested, and the test was excluded from the group report. The second test was

the Winch[23] reasoning test, which also proved too difficult for such young children.

Test No. 26, Reasoning. The third reasoning test[23] was better adapted to the children. It called for a judgment of the validity of reasoning. The little ones are better able to judge whether someone's else reason is a good one, than they are to initiate a reason of their own. The test is given in the following manner: "Some little children were asked, 'Why does not grass grow in winter?' I am going to tell you just what ten of them said and I want you to tell me each time whether the answer is a good one, whether it really tells why grass does not grow in winter, or whether it does not. One little girl said, 'Because it is winter now.' Is that a good reason?", etc. The other reasons given were: (2) Christmas is in winter, (3) Because it is too cold for it, (4) Because the ground is frozen, (5) We have fire in winter, (6) It needs hot sun, (7) Grass is green, (8) Winter is cold, (9) Grass grows in summer, (10) We go to school in winter. A score of 10 was given for each correct answer. Thirty-six children were tested; the average score was 54.1, M. V. 20.2, P. E. 17.1. The 100 percentile score was 100, the 50 percentile 60, and the 0 percentile 0. (Tables III, IV.)

f. *Psycho-Motor Ability*

We have included in our series a group of tests, the successful performance of which depends upon physical and muscular fitness and also upon a central motor control. These are neither purely physical nor purely mental tests. It is only by tests of this character that we can reach an expression of that very essential mental activity—volitional control of movement. Five tests were used; first, steadiness of right and left hand while effort is made to hold them motionless; second, steadiness of right and left hand while in motion; third, accuracy of aim with right and left hand; fourth, vital capacity; fifth, right and left hand grip.

Tests Nos. 27 and 28. Steadiness 1. The apparatus used for testing steadiness of hand while an attempt is made to hold it motionless is furnished by C. H. Stoelting Company, Chicago, and is called a steadiness tester. It consists of a metal plate set at an angle of 45°, and a metal stylus with a wooden handle. The plate is pierced by nine holes. The diameters of the holes successively diminish, measuring 32, 20, 16, 13, 11, 10, 9, 8 and 7 sixty-fourths of an inch

respectively. For the test, this apparatus was wired in circuit with a bell which rang when the metal plate was touched with the stylus. It was placed on a table in front of the arm the child was to use and the child was given the stylus and asked to hold it in the middle of the largest hole without touching the sides. Every time a movement of the hand brought the stylus in contact with the sides of the hole the bell rang. The examiner performed the test for each child to show him how to do it. The child was credited with the smallest hole in which he succeeded in holding the stylus without contact during the fifteen seconds. The holes were numbered according to size, 1, 2, 3, 4, 5 and so on. Each hole was used first by the right hand, then by the left.

The average score for the right hand was 1.19, M. V. .64, P. E., .53. For the left hand, the average was 1, M. V. .56, P. E. .47. The 100 percentile score for both hands was 3, the 0 percentile 0, and the 50 perceptile score 1. (Tables III, IV.)

Test No. 29. Steadiness II. The apparatus used in this test for steadiness of hand while in motion, was the tracing board, also furnished by the Stoelting Company. Two straight metal strips are mounted on glass, the distance between them diminishing from five mm. at one end to two mm. at the other. A wooden rule is mounted on the metal strips. A metal stylus completes the apparatus which, when wired in circuit with a bell, is ready for use. It is placed on the table directly in front of the child, who is given the stylus and asked to draw a line from the wide to the narrow end of the slit. If the stylus touches the metal strip on either side of the slit, the bell rings. The rule allows a reading of the distance covered before contact is made. The test was made with both hands, the right hand moving from left to right and the left hand moving from right to left, the position of the board being reversed for each change of hand. The score was the longest distance drawn without making contact, three trials being allowed, after an initial practice.

Forty-two children were tested. For the right hand the average was 6.47, M. V. 3.29, P. E. 2.48. For the left hand the P. E. was even greater and the results are omitted in the report. The 100 percentile score for the right hand is 15, the 0 percentile 0, the 50 percentile 7. (Tables III, IV.)

Tests No. 30 and 31. Target Test. For accuracy of aim, or the target test, we used the apparatus described above for tests No. 27

and 28, having the child place the stylus in the first four holes, according to rhythmic counting, 1, 2, 3, 4. This test was more successful than the steadiness tests, and the children enjoyed it more. Both hands were tested, alternate hands being used for successive trials, and three trials being given each hand. The score was the smallest hole entered without contact in the best of three trials.

The average attained by the 43 children tested was, for the right hand, 2.21, M. V. .69, P. E. .58, and for the left hand, 1.7, M. V. .77, P. E. .65. The 100 percentile score for both hands was 4, the 0 percentile 0, and the 50 percentile 2. (Tables III, IV.)

Test No. 32. Vital Capacity. The vital capacity was measured by the Wet Spirometer furnished by the Stoelting Company. This instrument measures the maximal amount of air expelled from the lungs after a full deep inspiration. The subject is directed to take a deep breath, then to breathe out through a tube placed in the mouth and connected with the Spirometer.

By many this may be considered purely a physical test, but the part played by the volitional element is appreciated when the test is applied to feeble-minded or to young children. Many of these children who have excellent lung capacity cannot control their performance sufficiently to demonstrate their capacity by this test, simple as it may seem. The records of vital capacity secured by H. H. Goddard[8] and E. A. Doll[8] from feeble-minded children at Vineland, New Jersey, and by Smedley[20] and De Busk[7] for retarded public school children, indicate this fact.

Before letting a child use the spirometer, the experimenter always demonstrated the method in order to give the child an idea of how to proceed. The effort was made to evoke enthusiasm over blowing it high. The enthusiasm was easy to arouse, but it was often necessary to allow the child some time to practice in order to secure any satisfactory performance. Many found it difficult to blow in the mouthpiece and allowed the breath to escape around it, while others gave a series of little puffs, not comprehending that the cylinder was to be blown up in one expiration. The vital capacity of many of our group is no indication of the maximum amount of air taken into the lungs or expelled from them, the record representing a small fraction of this air. The score in these cases is really an index of the mental inability of the child to conform to the rules of the test.

Forty children were tested, the average score being 760 cc., M. V. 204.01, P. E. 172.44. Smedley's 100 percentile score for girls of five is 1150. The highest score obtained by girls of five in our group is 984, which falls between Smedley's 90 and 100 percentile. Smedley's 0 percentile score for the same group is 600, while our lowest scores are 246, 401, 492, and 574. There are four six year old girls in our group, and all of these have scores lower than Smedley's 50 percentile score. (Tables III, IV.)

Tests 33 and 34. Grip. The grip was measured by the Smedley Dynamometer, the instrument being adjusted so that its outer frame rested against the fleshy base of the thumb and the inner stirrup against the second phalanges of the fingers. The test was performed for each child to show him how and he was urged to squeeze harder and harder while he was squeezing. The children all put forth much effort, but much of this went into grimaces and contortions of all sorts. Three trials were given with each hand and the hands were used alternately.

Forty children were tested, the results for the right hand being, average 7.8, M. V. 1.9, P. E. 1.6, for the left hand, average 7.33 M. V. 1.41, P. E. 1.19. For girls of five, Smedley's 100 percentile score for right hand is 13, left hand 11.5. Our highest score for right hand is 11, left hand 9. Smedley's 0 score for right hand is 3, for left hand 2. Our lowest score for right hand is 3, for left hand 4. For girls of six Smedley's 100 percentile score for right hand is 15.5, for left hand 15, while our highest score for right hand is 13, for left hand 12; Smedley's 0 score for right hand is 4, for left hand 4, our lowest being 6 for both hands. Our one seven year old girl gave an eight year 100 percentile score, for the right hand test. She had no fingers on the left hand.

For boys of five Smedley's 100 percentile scores are right hand 16, left hand 15.5. Our highest scores for the right hand are 11, for the left hand 9.5. Smedley's 0 percentile score for the right hand is 4, for the left hand 3. Our lowest for the right hand is 5, for the left hand 5. For boys of six, Smedley's 100 percentile scores are 16.5 for each hand. Our highest scores are 12 for each hand. Smedley's 0 percentile score for the right hand is 5, for the left hand 4. Our scores are right hand 7, left hand 6. Our seven year old boys made a Smedley 50 percentile score with the right hand i. e., 12, and a Smedley 20 percentile score with the left hand,

i. e., 10. Again we found our oldest children, the retarded ones, made the poorest scores. Our scores are consistently lower than those of the Smedley tables.

(g) *Learning*

As one of the most essential abilities for a little child is the ability to learn, we considered it important to include a group of learning tests. Six were used, none of which required ability to read or to write.

A test requiring the substitution of number names in the color naming test and one requiring the substitution of numbers for the names of geometric forms were discarded as too difficult.

Tests No. 35 and 36. Healy-Fernald Puzzles A and B. The Healy-Fernald[10] Puzzles A and B may be used as learning tests. After the first successful placing of the blocks, the child is asked to "Do it again," and this procedure is repeated until the task is accomplished in the least possible number of moves. The child has then learned how the pieces should be placed. The number of trials used in this learning process are recorded together with the time consumed in the last and perfect placing. The efficiency index is computed by the following formula: $\frac{A \times 100}{T} = E.\ I.$ $A =$ accuracy and $T =$ time. For an accuracy score, 100 is assigned if only one trial is required to secure success in the least possible number of moves; if two trials are used the accuracy score is $\frac{100}{2}$; if three repetitions are used the accuracy score is $\frac{100}{3}$, and so on. The time consumed in the last, or perfect, placing is used as the time score. Forty children were tested with A. of whom seven failed entirely. For the 33 who finally learned the exact position of the blocks, the average efficiency index is 307, M. V. 152, P. E. 129. The 100 percentile score is 769, the 50 percentile score 250, the 0 percentile 79. (Tables III, IV.)

The Healy-Fernald Puzzle B[10] was used with 40 children, five of whom failed entirely. The remaining 35 attained an average efficiency index of 125, M. V. 65, P. E. 54.9. The 100 percentile score was 350, the 50 percentile score 83, and the 0 percentile score 40. (Tables III, IV.)

Test No. 37. Wiring. The fourth learning test was suggested by the interest the little boys took in the wiring of the apparatus for the steadiness test. A bell was placed in the circuit with the

apparatus, and every touch on the metal plate by the stylus rang the bell. The children were curious to know what made the bell ring and asked questions about it. The examiner told them she would show them and then let them put in the wires. She wired the instrument while they watched, then disconnected it, and told them to wire it again. There were two dry cells, the steadiness tester, the bell and the stylus in the circuit. If the child wired the bell correctly after one demonstration, he was scored 100, and this score was divided by the number of repetitions required. Forty-two children were tested, four failed; the average score for the remainder was 70, M. V. 22, P. E. 19. The 50, 60, 70, 80, 90 and 100 percentile wired it correctly after one demonstration. Although only one demonstration was required, there were different grades of success represented which do not appear in the method of scoring used. Some children made and corrected errors, although they were shown only once. This was a particularly popular test; indeed, it was the invention of the children themselves.

The test requires accurate visual perception of position and movement and a considerable amount of concentration, and it is valuable because it requires no information or understanding of a description. (Tables III, IV.)

Test No. 38. String Games. The sixth and last learning test is one which perhaps has never before been used for this purpose. We have long thought that the Indian string games, which have a wonderful fascination for many children, might be used as a mental test. The learning of these games requires a very accurate visual perception of movement, of position, and of form, and also considerable control over hand and finger movements. The extent of almost any child's experience in the games is the familiar cat's cradle and the saw, and very few children seemed to know even these. A series increasing in difficulty was arranged and the five easier games among them used as a learning test with the kindergarten group. The material required is simply two circles of string (the joining being made particularly smooth), one for the demonstrator's and one for the children's use. The experimenter sat at the right of the child so that the child could face as she did while watching her hand movements. The examiner placed the string on her hand in the fundamental position for most of the

games, took it off, and asked the child to do the same. Three demonstrations were given if necessary and if the child succeeded, a more difficult positon was tried.

A credit of 20 was given for each step successfully copied, a perfect score, 100, requiring success in five distinct steps. The series used was: (1) position one; (2) opening one; (3) tent; (4) spearing fish; (5) house. The little ones were interested in these games and much pleased when they succeeded in learning them. Thirty-six children were tested, three failed, the 33 successful ones attaining an average score of 41.8, M. V. 18, P. E. 15. The 100 percentile score is 80, the 50 percentile score is 40, and the 0 percentile 0. The test will, perhaps, prove useful for older children because it calls for accurate perception and much concentration without making any demand upon language or information of any sort. (Tables III, IV.)

The games were taken from a book by Kathleen Haddon, called *Cat's Cradles from Many Lands.*

h. *Suggestibility.*

The suggestion tests are six in number. Two of them are designed to influence judgments—one requiring judgment of the length of lines and one judgment of weight. Two are designed to produce sensory hallucinations one of smell and one of taste. Two aim to measure the tendency to establish automatisms.

Test No. 39. Suggestion of Length. The test designed to influence judgment of length of lines was first used by Binet.[4] The material consists of a series of horizontal lines drawn on a sheet of white paper at varying distances from the margin. The first line is one inch long, the second two inches, the third three inches, the fourth four inches, the fifth five inches and thirty-two others are each five inches long. The suggestion is given entirely by the order of the first five lines. Each line is very plainly longer than the one preceding it and by the time the fifth line is observed the suggestion that each line of the series will be longer than the line preceding it has been given by the material itself.

The procedure is as follows:—one line is shown at a time, all others being covered. To the child is said, "I want to see how well you can judge length, how well you can tell whether one line is longer or shorter than another line. I shall show you one line at a time and I want you to tell me every time I show you a new line

whether it is longer or shorter, or just the same as the line you saw just before.'' Then the examiner shows the one inch line, covers it and shows the two inch line, saying, ''Is this longer or shorter, or the same?'' Then she covers the two inch line, showing the three inch line and saying, ''Is this longer or shorter or the same?'', then covers the three inch line, showing the four inch line and asking the same question. After the fifth line she shortens the question, saying, ''And this one?'' Thirty-five children succeeded in performing this task. Of the 35 only one was entirely uninfluenced, judging all the five inch lines as ''the same.'' Twenty-eight children, or 80 per cent, were totally suggestible, giving no judgment of ''the same;'' three were unequal to the task, not having sufficient power of application to complete it. (Tables III, IV.)

Test No. 40. Suggestion of Weight. The test designed to influence judgment of weight is also an invention of Binet.[4] The material comprises 15 black wooden bottles, plainly numbered in white on the top, 1, 2, 3,......15. No. 1 weighs 20 grams, No. 2, 40 grams, No. 3, 60 grams, No. 4, 80 grams, No. 5 and the other ten all 100 grams. Again the suggestion is given entirely by the order of the material. Each bottle lifted, up to and including the fifth, is very evidently heavier than the one immediately preceding it and that fact establishes the suggestion. The examiner says to the child, ''I want to see how well you can judge weight, how well you can tell which is the heavier of two bottles. First I want you to pick up this bottle (lifting No. 1), then to lift this bottle (lifting No. 2) and while you have it in your hand tell me whether it is heavier or lighter than No. 1, or just the same as No. 1. Then put it down, lift up the next and tell me whether it is heavier or lighter than No. 2, or just the same; then put it down, lift the next and tell me whether it is heavier or lighter than No. 3, or just the same as No. 3.'' She proceeds in this way to the fifth and then says, ''And do the same with all the other bottles.''

Thirty-five children succeeded in performing this test. Three failed because they could not judge correctly between the difference of the first five weights. Of the 35 who succeeded, one was uninfluenced by the suggestion, judging the last ten weights equal and the other 34 were totally suggestible, not one judgment of equal being given by any one of them. (Tables III, IV.)

Test No. 41. Suggestion of Odor. The test material used for pro-

ducing an hallucination of smell consisted of a little bottle of lilac perfume and another bottle of tinted but unscented water. The child was given the perfume to smell and asked what it was. The usual answer was perfume, but sometimes the child did not know the word perfume and simply said, "good" or "nice". Then the other bottle was presented, with the same question.

Thirty-six children succeeded in performing this test. One failed through lack of attention. Of the 36, 21 (58 per cent) responded to the suggestion, answering that the second bottle contained perfume. Fifteen children could smell nothing when given the second bottle. There is perhaps little doubt that 58 percent of the children were really suggestible, but there is a doubt that an hallucination was present in all cases. In some instances it seemed that the children said they smelled perfume because they thought it was perfume and thought they were expected to smell it, not because they really thought they smelled anything. (Tables III, IV.)

Test No. 42. Suggestion of Taste. The material used for producing an hallucination of taste was similar to that used for producing a sensation of odor. Three bottles, one containing very sweet water, one slightly sweetened water, and one unsweetened water were used. The experimenter told the child she wanted to find out how well he could taste, reassuring him by telling him that what she gave him would taste good. Then with a piece of absorbent cotton she touched his tongue with the sweetened water, which he watched her take from the bottle. He, of course, said it was sweet, or tasted like candy. Then she used the slightly sweetened water, asking whether he could taste the sugar in that, and finally used the unsweetened water, asking the same question.

Of the 35 children who succeeded in performing this test 15 were suggestible, claiming they tasted sugar in the unsweetened water. There was much greater surety of statement regarding taste than smell. The children were clearly less suggestible to taste than to smell. Only 40 per cent were suggestible in comparison with 58 per cent. (Tables III, IV.)

M. H. Small[19] of Clark University, used practically this same method for testing school children en masse. His results are rather startling. He found that in using the test designed to produce the hallucination of odor, 98 per cent of 93 children in the first grade were suggestible and 95 per cent of 62 children in the second grade

were suggestible. In the test designed to produce hallucination of taste 98 per cent of 94 pupils in the first grade and 90 per cent of 70 pupils in the second grade were suggestible. Of course in these tests there was an added element of suggestibility in the behavior of the other children of the class.

Test No. 43. Automatism—Taps. The two tests designed to establish an automatism are borrowed from Rossolimo.[17] The first we call the tapping test. The child is given a pencil and the experimenter says, ''I want you to tap with your pencil just as I do. We will tap together ten times.'' If the child continues to tap after the experimenter stops at ten, the automatism is considered established.

Thirty-eight children performed this test and all of them tapped at least once more than the ten times. The record for this test therefore is 100 per cent suggestibility. (Tables III, IV.)

Test No. 44. Automatism—Eye—Hand. The second test of automatism consists of asking the child to shake hands with his right hand and to close his eyes while he does so. After the lapse of about half an hour during which the child has been otherwise employed, he is asked to shake hands with the left hand. If the suggestion holds, he will close his eyes as he shakes hands. Of 38 children so tested 21 closed their eyes while shaking hands with the left hand. Seventeen failed to do so. Fifty-five per cent of those tested had established in one performance a strong association between the acts of shaking hands and closing eyes. (Tables III, IV.)

These last two tests illustrate how easy it is to establish habits, how rapidly new associations between stimuli and motor responses can be set up. They show how important it is that parents and teachers take infinite care while the children are young to establish desirable motor responses and to guard against the undesirable which are all too easily established.

3. *Complex Performance Tests*

Test No. 45. The Maxfield Cube. The Maxfield cube test is so named because Dr. Francis Maxfield introduced it, although the actual patterns used by us may not be the same as those used by Dr. Maxfield. The cubes used are the color cubes sold by the Bradley Co. They are one inch cubes and present one blue, one yellow, one red, one white surface, one surface blue and yellow, and

one red and white, the colors on the last two surfaces meeting at a diagonal. These blocks lend themselves readily to the formation of geometric designs of varying degrees of difficulty. Four blocks were used, each child being given four similar ones. The blocks were arranged in a pattern on a table before the child and he was asked to make a pattern like it with his blocks. The patterns used were the following:

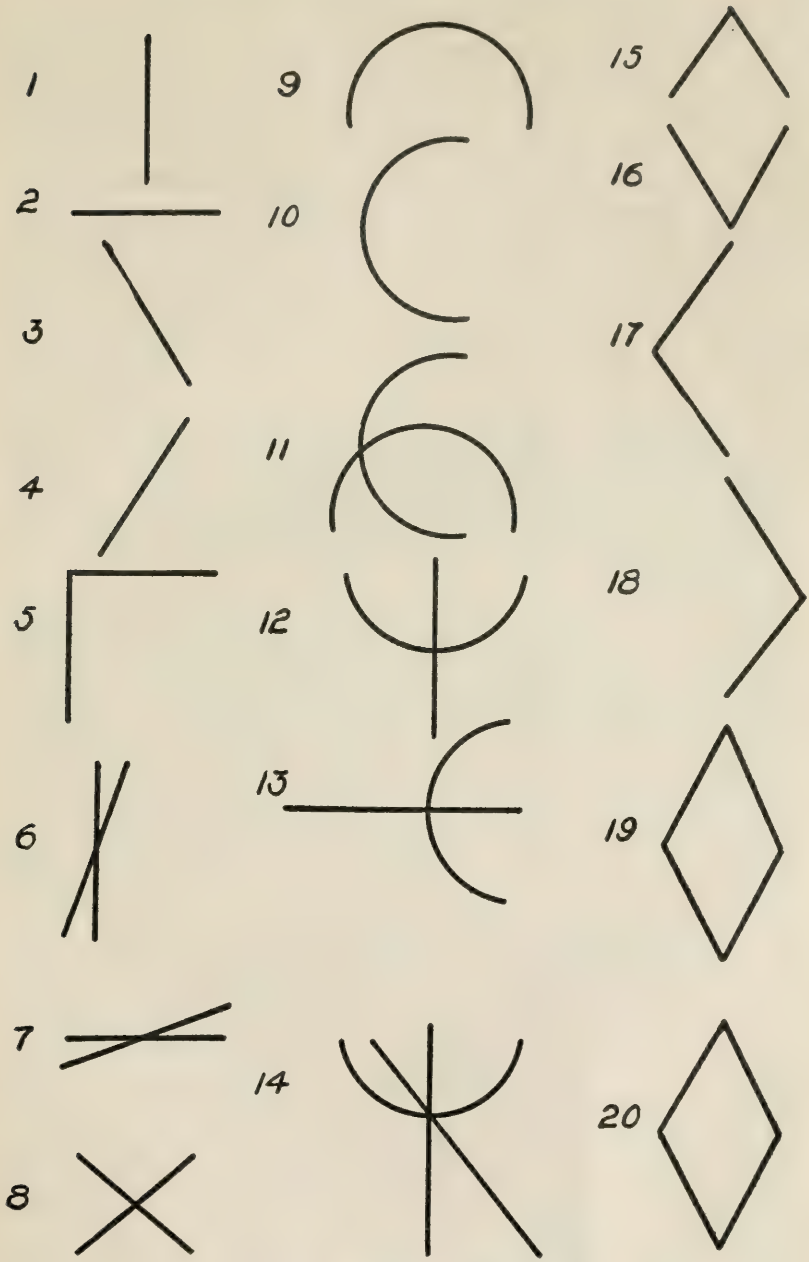
1. Solid square of one color
2. Square of yellow within square of blue
3. Two white tents or soldier caps, one under the other
4. A diagonal stripe of white on a red surface
5. A chevron of yellow on a blue surface
6. A pin wheel.

Success in forming all six designs gave a score of 100, each success contributing 16.66 toward the score. Forty-five children performed the test, the upper 20 per cent making a perfect score, the 60 and 70 percentiles making 83.3, the 40 and 50 percentiles 66.64. Av. 67.02, M. V. 23.35, P. E. 19.74. (Tables III, IV.)

The test requires in its performance accuracy of both color and form perception, the ability to perceive slight differences of form and position in a pattern containing several varieties of both, and the ability to analyze the total perception into its block units, concentrating on each in turn to the exclusion of the others. It was considered too complex to be included in the group perception tests. Care was taken in that group to isolate as much as possible each form of perception. Good scores are often made in the perception tests by children who can do little with the cube test.

Test No. 46. The Seguin Formboard. The older Witmer model of Seguin formboard was used, the same board as that used by Dr. Sylvester[21] in his experiments. As our children are only five years old, the Sylvester norms are not applicable and a slightly different procedure was adopted.

Each child was allowed to repeat the test up to the limit of ten times until he had succeeded in one trial in placing all the pieces without errors. The child was shown that each block fitted into one hole and one only, and was then told to put them all in, each in the hole in which it belonged. Before the second attempt the examiner said, "Now let's try it again, and this time you will do it just as well, and a little quicker." Sometimes even this mild suggestion of



Material for Line Reproduction Test (No. 47)

haste spoiled the accuracy, but often it had no effect whatever, the child not attempting to hurry.

A record was kept of the number of errors made and the time consumed in each trial. In computing an efficiency index the number of trials instead of the number of errors was used as the accuracy index, and a child's accuracy index was determined by dividing 100 by the number of trials used before accuracy was attained. For instance, child No. 3 placed all blocks correctly without error on the second trial; her accuracy was 50. Child No. 4 used six trials before attaining a perfect performance; her accuracy was 16.66. For the time-score the time of the last trial, a perfect performance, was used. The formula used is $E=100\frac{A}{T}$. $A = \frac{100}{\text{No. trials}}$; T = time of last trial. Child No. 3 used two trials; time of the last trial was 28 seconds, therefore $E = 100\frac{50}{28} = 178$.

Forty-two children performed the test, three failing to attain a perfect performance in the ten trials allowed. The efficiency index ranged from 45 to 333, the average was 158, M. V. 70.9, P. E. 59.9. (Tables III, IV.)

Test No. 47. Line Reproduction. Lines and combinations of lines were drawn before the child one at a time with the instruction that he draw one like it. The accompanying lines were used. A credit of 2.5 was given for Nos. 1, 2, 3, 4, 9, 10, (one line figures) a credit of 5 for Nos. 5, 6, 7, 8, 11, 12, 13, 15, 16, 17, and 18 (two line figures), and a credit of 10 for Nos. 14, 19 and 20 (three and four line figures, presenting difficult angles). The performance of this test involves visual perception of the position of lines, complicated by the reproduction of this perception graphically. Involving as it does the coördination of hand movements, this test does not depend upon visual perception so much as upon the power of visual perception to direct and control hand movements. This control may be weak on account of poor visual perception, or on account of lack of association between the visual perception and the idea of the movement to be made. Success in this test might be expected to indicate ability to learn to write, as it calls for the same combination of abilities in a simplified performance. If this expectation is realized the test will be a valuable prognostic test, inasmuch as it will indicate the probable ability of a child to succeed in school work.

Thirty-eight children were tested; the lowest score was 13.5,

the highest 90 (attained by the 100 percentile only), the median score was 47.5, the average 48.7, M. V. 19.8, P. E. 16.7. (Tables III, IV.)

Tests No. 48 and 49 have been discussed under General Intelligence Tests, page 38.

Test No. 50. The Knox-Pintner Cube. For this test four black cubes from the Stoelting Co. Binet set were used. They were placed on the table before the child and he was given a pencil and told to "Do just what I do after I have finished." Pintner's[13] order of touching the blocks was adhered to and his age level scoring followed.

Success seems to depend upon power of concentration and accuracy in perception of position and movement. This analysis is somewhat vitiated, however, by the fact that if the subject happens upon the trick of numbering the blocks 1, 2, 3, 4, and remembering the number names of the successive blocks tapped, the process becomes largely one of verbal memory and is much simplified. Forty-four children were tested and their age scores compared with their chronological age. The variation in performance was so great, ranging from two years less than chronological age to 11 years in excess of it, that the results throw some doubt upon the claim that the Pintner norms are correlated with chronological age. The results are presented in graphic form in Chart 1. The graph shows three modes. The largest group, 13, made exactly their chronological age score; only four failed to make a score corresponding to their chronological age, the other 27 exceeding it from 1 to 11 years. (Tables III, IV.)

Test No. 51. The Porteus Maze. The Porteus Maze test, or the motor intellectual series, as Porteus[14] originally designated it, consists of a graded series of mazes of increasing difficulty, adapted to testing children of ages six to 14 inclusive. These mazes are preceded in the series by three simple tests which call for the drawing of outline figures between the guide lines, for the years three, four and five. The figures are diamond, four pointed star, and maltese cross. Porteus claims that the successful performance of these tests depends upon prudence and forethought, mental alertness, and sustained attention. These qualities, he writes, are left untested by the Binet intelligence scale and he offers this motor intellectual series as a supplementary test to make more complete the estimate of the child's mentality. Porteus, however, in

his latest monograph on the maze test, September 1919,[15] has revised the series, substituting new tests for six and seven years of age, shifting the old five year test to four years, the old six year test to five years, and discarding the original four year test. The change, of course, affects the scale most at just the levels used in our investigation, and our age scores might have shown a greater correlation with chronological age had the new series been used.

Our results are scored according to the original Porteus[14] method and compared with his original norms attained by the examination of a thousand children in Melbourne, Australia. Three of the 43 children examined by us passed just at age, three one year below age and the other 37 ranged from one to eight years in excess of their chronological age. The results are presented in graph form in Chart I. There are two distinct modes, one at two years above chronological age, twelve cases, and one at four years above chronological age, eleven cases. These results show little correlation with chronological age. (Tables III, IV.)

VI. TYPE CASES

In order to gain a knowledge of the social setting of each child, it was our plan to have a person trained in the work of social investigation visit each home and learn those facts about the family life which would help us to an understanding of the child's characteristics and of the influences which had been moulding him during the five short years of his experience. No such person was available, and in order to complete the study, which had already nearly reached its goal, the writer undertook to make the visits to the homes herself. As a result, she has in mind in thinking of each child a picture of him as one of a home group which is quite as vivid as her picture of him in the schoolroom or in the laboratory. The picture of B. D. is that of a little child stamping into the house demanding that her mother give her a piece of bread at once; it is followed by one of the mother's worried face as she comes to the office at four in the afternoon in the midst of a snowstorm, in a vain search for the child, who already at five thinks she can manage her affairs far better without her mother's aid. E. is thought of in a cluttered, dirty, hopeless room into which she led the way to the mother's evident shame. The setting of the picture of D. is a tiny home, very pretty, in immaculate order, a beautiful and happy young mother enjoying her baby and finding

ample time to keep her house and make her clothes, and care for her three children. "I do not have too much to do," she said. "I think it is because I plan my work."

The children were, for the most part, children of working men, men employed in factories, on the railroads, and in the shops. There were a few salesmen and one professional man. The majority of the families lived in small wooden houses with porches, and sufficient rooms for comfortable living. The house work was done by the mothers, who seemed to have sufficient money to live comfortably on this modest scale. Most of the houses indicated that there was a little more than enough money than was required for absolute necessities. In many of the homes there was a victrola, a few had a piano, and most of them displayed articles of various kinds whose chief function was to beautify the home. There were a few families that shared their houses with other families and evidently had more difficulty in meeting the absolute expenses of life. On the whole, all the children came from homes of about the same economic level. The individual differences in the home environment, which were very striking, depended evidently upon the intelligence and temperament of the mothers. All of the mothers were endeavoring to make the home conditions as comfortable as possible, but some of them were sadly in need of knowledge which would have enabled them to succeed, and some of them were lacking in the force of character which is necessary to bring up a family of children in an intelligent manner.

There is a current notion that the native intelligence of an individual decides the social and economic level to which he attains. Contact with the mothers and fathers of this group of children leads one to doubt the truth of this theory. Among these people, who are likely to remain at their present social and economic plane, were found men and women of superior mental endowment, who, if their careers had started on a higher cultural and economic level, would doubtless be filling a place in the professional world today. It is not poverty of mental endowment which keeps the parents of this special group where they are; it is poverty of mental experience. They were not unintelligent, but untutored and uncultivated.

We are not presenting a statistical report of the social findings, as their value lies wholly in the relation of conditions in the individual homes to the quality, mental and physical, of the

children these homes have sent to the schools. Instead, short sketches have been prepared for each child, which state the salient facts gleaned from the family visits and the physical and mental examinations, and are aimed to present a fairly complete picture of the individual children. A few typical sketches follow.

Child No. 1. Johnny was the first child brought to the office because he was an unsolved problem in the schoolroom. The difficulty was that the child refused to talk, his efforts limiting themselves to pronouncing his own name. During the first fifteen or twenty minutes he did all that was asked if no speech was required. He answered all questions that a nod or shake of the head would dispose of, but he spoke no word. Finally, when all toys and games had failed to appeal, he was asked, ''What would you like to do?'' and the answer came in a burst of tears, ''Go home.'' He was told, ''Of course you may go home if you want to,'' and while he was being comforted and his coat put on he talked a little. This talk revealed an infantile stammer. In the afternoon the mother came to see what was going on, and brought her younger boy with her; the two children chattered together in a language unintelligible to others. The younger brother never uses this form of talk except to Johnny. The mother does not like Johnny to talk so queerly and tries to shame him out of it. The result is a self-consciousness which prevents Johnny from talking at all. The mother's attitude is a little resentful that Johnny is as he is, and a little resentful that we notice it, and she unconsciously lets this feeling affect her treatment of the boy. The home is a second floor flat. The father is of Swedish parentage. There is plenty of money to buy the necessary food, but the mother is of the opinion that children should not be made to eat anything which they do not like. The house is clean and well kept, as are the children. There is no attempt to beautify the home, but its bareness is more an indication of lack of feeling for beauty than of poverty. The boys play together constantly and are much on the street.

Johnny was a healthy baby, was nursed by his mother, and has never been seriously ill. He is quite cross-eyed, and an examination of his eyes revealed the fact that the vision of one eye is four-tenths, and of the other one-tenth. His tonsils are very large, he needs circumcision, he has flat foot, bow legs, protruding scapulae, eleven carious teeth, and the haemoglobin content is 75. Johnny is a little overweight, and it would seem, must have much physical vigor to

withstand as well as he does so many physical defects. The mother at once had his eyes examined and procured glasses; the other defects have not been remedied.

The mental examination revealed as many weaknesses as did the physical. At only six points does his profile curve pass the 50 percentile. One of these points shows no ability, but as it was a suggestion test in which the whole class followed the suggestion, the 100 percentile really means participation in class failure. One suggeston test was successfully resisted, the 60 percentile was reached in one discriminative attention test, and the 70 percentile in the other. The 60 percentile was also reached in the picture memory test, the 70 percentile in the first steadiness test for the left hand (which is his preferred hand). The peaks are rare in this profile, which occupies almost constantly the lower part of the graph. In all the performance tests and in the general intelligence tests he falls behind, testing just at age or in the 30 percentile by Binet, and one year retarded or in the 0 percentile by the Stanford revision. He graded at the 50 percentile in the Knox-Pintner cube test, and the 0 percentile in the Porteus test.

The physical and mental pictures of this little boy are strikingly similar, defects being so numerous that one almost despairs. Nevertheless, there are so many points of attack for helping Johnny that there is much to do before we give up. The mother is worried over him and will do all that she is convinced is right to do. She feels that the school should provide special training for children with such speech defects, and rather resents being told that Johnny should have special training when the schools obviously do not provide it.

Without the correction of his physical defects, and in addition special training, the prospect for Johnny is not good. With these it is possible that much may be done to help him.

Child No. 2. Anna is a little girl who came to us on her fifth birthday. She is fat, rosy and six pounds overweight. She was a healthy breast-fed baby. At six months she had whooping cough and developed eczema on her head and body, which has continued in spite of various treatments ever since, though now it is confined entirely to her body.

The home is a very comfortable working man's home, a small wooden house with porch, the kind common in this neighborhood. The house is furnished well with some thought to decoration, but

almost too plentifully supplied with pictures. There is a piano and the young mother is studying music. The parents are socially inclined and ''go a great deal'' in the evenings, always taking Anna because she can not be left alone. She gets very little sleep, taking no nap and going to bed late. She drinks no milk, eats principally potatoes and gravy and fruit.

She is a bright, happy, little thing and shows no nerve signs in spite of loss of sleep and poorly balanced diet. Medical examination, however, revealed a heart murmur and enlarged tonsils and adenoids. The haemoglobin content is 95, the highest for any child in the group. Her psychic profile shows a rather even fluctuation above and below the median percentiles. Her lowest scores occur in imagination and psycho-motor ability. In general intelligence she tested just at age, both by the Binet and Stanford Revision Intelligence scales. Strong in attention, she scored five years beyond her age in the Knox-Pintner Cube test, but this only puts her in the 80 percentile group.

Medical care, change of diet, and regular hours are greatly to be desired for this little girl. Although she does not now to any great extent show the bad effects of the unwise home regime, it can hardly be expected that many years will pass before very grave results will be evidenced. The greatest lack in this home is a knowledge of the proper daily routine for a child. She receives devoted care, but it is very unwisely directed. There is no doubt of her future satisfactory mental progress.

Child No. 3. Sophie is the picture of health, four pounds heavier than the average for her age, with rosy cheeks, bright eyes, and an alert, emotional and lovable disposition. She has an infantile stammer which persists because she uses it in a very appealing way which brings an appreciative smile from all hearers. Unfortunately, a careful medical examination did not justify the appearance of abundant health. The bright eyes had not quite perfect vision, the cervical glands, the inguinal glands, the tonsils and adenoids were enlarged, there was a heart murmur and two teeth were decayed. The haemoglobin content was however, rather high—83.

The mother reports that Sophie did not have a very good start in life; the birth was difficult, the child small and sickly and the mother had not sufficient milk to nourish her. She has suffered no serious illness since.

The mother was much disappointed in the medical report because

Sophie is the baby and the pride of a very happy and united little family. The parents are Russian Jews, the father a junk dealer. The home, which is of the usual small wooden type, is not only comfortable but attractive. The family spirit is very beautiful and the attitude toward strangers cordial and hospitable. Sophie drinks one quart of milk a day and it is very evident that there is plenty of good food for the child.

Sophie's emotionalism showed itself in an outburst of temper. She thought herself deceived and slighted by her older sister and stamped and sobbed and would not be comforted. The mother had little control over her. The child is much loved and the sweetness of her nature has been developed thereby, but unfortunately, not her self-control.

The psychic profile lies for the most part high on the chart, although the imagination drops very low and also the vital capacity In general intelligence she is a year in advance by the Binet series, and just at age by the Stanford Revision.

Sophie's chief need is that her parents be guided to give her proper medical, dental and hygienic attention. The parents desire to do well for their children, but they are themselves at the point where one hot bath a week seems sufficient and the cleaning of teeth is entirely overlooked. Special training should be given at once to terminate the infantile stammer, which if it continues, is very likely to interfere with her mental progress. With medical care and speech training provided, satisfactory mental development is certain.

Children Nos. 4 and 5. Erma and Effie are twins, and the only children of the family. They are tall and thin, rather pale and breathe through their mouths. All that is said of one may be duplicated for the other, for they are almost identical in appearance, voice, gesture, temperament and mental type.

The home is an exceedingly comfortable one, kept so by thrift and industry on the part of the mother. She makes attractive dresses for the children, sometimes, according to the little girls, "from our grandmother's." She also crochets lace for sale among her friends. There is a piano and a victrola in the living room. The mother manages the little girls as well as she manages the home economy; they are well behaved, obedient and go to bed every night at eight o'clock. They give the mother no trouble, are tremendously

interested in her fancy work and in all that she does, and are demonstratively affectionate toward her.

The mother is of German descent. The father's ancestry is obscure. The children were delivered by instruments, they were nursed by the mother and have had no illnesses, not even the ordinary children's diseases.

In spite of this account of good health, the medical examination confirms the general impression the children give of poor physical condition. It shows enlarged tonsils, adenoids and cervical glands, malnutrition, umbilical hernia, flat foot, protruding scapulae and many carious teeth, among which are permanent molars. The quality of their voices is spoiled by the enlarged adenoids, which prevent nasal breathing, and their beauty is marred by their open mouths. The undernourished condition is probably largely due to the absorption of pus from tonsils, adenoids and teeth. The problem is serious because the father resents even a physical examination of his children. An effort should be made to reach the father and to convince him of the physical needs of his little ones, and the inevitable suffering their neglect will bring upon them.

Both little girls have reached the same general intelligence level, scoring the 100 percentile in the Binet series, and the 90 percentile in the Stanford Revision, thus showing a two and a one year acceleration. Their psychic profiles are alike in type. Their mental ability is undoubtedly of a high order.

Child No. 7. Edwin would attract attention anywhere with his keenly alert, strangely mature little face and undersized, undernourished little body. He is entirely lacking in childishness; no trace of the baby remains, although he is but five years of age. He is a little on the defensive, distrustful of strangers and entirely determined to do as he pleases.

The physical examination showed him to be five pounds lighter than the average for his age, to have a haemoglobin content of 75, to be partially deaf in the right ear (the result of former middle ear disease), and to have a slight scoliosis, with protruding scapulae. He had already been circumcised.

The mother, who is a woman of refinement and ambition, although without much education, is almost in despair concerning the boy, who from the first has been a nervous, irritable, sickly little thing. He is the only child living, coming to the mother late in life after she had lost several babies. The birth was difficult, the

mother's milk did not agree with Edwin nor did other food, and he has always had great trouble with constipation. The mother, instead of regulating his food wisely, constantly resorts to laxatives. On account of his sickliness he has been humored until now he is entirely beyond his parents' control. He eats what he chooses irrespective of consequences and the mother is unable to prevent him without precipitating such a scene that she prefers to keep the peace. The mother is of English parentage, the father probably of Irish descent. There is money enough and good will enough to do all possible for the boy, but his training has been wrong from the start and the child now has full control of everything but his temper.

In the intelligence tests, Edwin reached the 70 percentile with the Binet tests, which signifies an acceleration of one year, and the 60 percentile in the Terman Revision, signifying his chronological age level. It was impossible to make a thorough mental analysis in Edwin's case because he absolutely refused to cooperate.

Child No. 8. Isadore is an only child. The father is a mechanic of Swedish descent. He measures six feet two inches, and is physically a splendid specimen of manhood. His mind is no mean match for his body, and had circumstances started him in a different groove he could easily have qualified for a profession. The mother is Pennsylvania Dutch.

The home is a good one. The furnishings are of good quality, the pictures well chosen and the rooms tastefully arranged.

Isadore is very lively and energetic, and the mother fears that he will find out that his will is stronger than hers. He was a healthy baby, nursed by the mother. His only illnesses have been mumps and measles. He drinks plenty of milk and is a well brought up, attractive boy.

The physical examination shows enlarged cervical glands, adenoids and tonsils, a slight dullness of hearing, a haemoglobin content of 72, and protruding scapulae. He needs circumcision. As the parents are decidedly intelligent and much interested in our efforts to help the child, Isadore will probably be given the individual aid which he needs.

His mental profile shows very few dips into the lower half of the graph. In general intelligence he only made the 30 percentile on the Binet test, and the 60 percentile in the Stanford Revision. This is exactly his chronological age grading.

Child No. 9. Daisy, aged five, has the independence of a woman of forty. She wishes no interference to detract from the effect of her own personality. On entering kindergarten for the first time, she decided to go alone, and she wishes to choose her own clothes and her mother's too, for that matter. Her parents are American. The mother is attractive in person and very mild and unassertive in temperament. The father is a farmer and is away from home a great deal. The mother is not very well. She has rheumatism, in the hope of relieving which she has had her appendix, tonsils and several teeth removed. The home is very small. It is very clean, but only moderately neat and comfortable.

The child has absolutely no respect for her mother's word or opinion. The mother realizes this and complains that the father has always spoiled the child by allowing her to do whatever she fancies. He began when she was an infant by insisting that the mother drop everything and take her up whenever she began to cry. The health crusade appealed to the child and led her to demand milk and cocoa for the first time. Previously she demanded tea and coffee in spite of her mother's protests. Now she as determinedly refuses to touch them. She sleeps ten hours each night. She is five pounds heavier than the average for her age and her only physical defect apart from the low haemoglobin content (75) is very defective vision. The mother had this corrected by glasses immediately upon being notified of the condition.

Daisy's psychological profile shows a weakness in imagination and in the perception of grays. Her general intelligence, which is at the 70 percentile in the Binet series and the 60 percentile in the Stanford Revision, is by the former two years accelerated and by the latter exactly at her chronological level. The most remarkable thing about the child is her tremendous self possession and independence. She was most valuable to us as a pilot for all the shy youngsters and helped us over many difficult places with them. Her confidence in herself has evidenlty been gained at the cost of respect for her mother. She is, however, of a sunny bright nature which makes everyone like her in spite of her abnormal amount of assurance. Guidance by a wise strong woman is what is needed for Daisy.

Child No. 10. Theodore is the last of four children. The parents are of English descent. Both parents are people of native refinement, but the cost of living has proved too much for them and the

pinch of poverty is plainly visible. All four of the children are mouth breathers. They all have enlarged tonsils, adenoids and an offensive nasal discharge. Fortunately, the parents were glad to send all the children to the Children's Hospital in Iowa City. Theodore's tonsils and adenoids were removed and his antrum punctured. Just one month later he had to return for a second puncture of the antrum. His medical examination also showed enlarged cervical glands, a haemoglobin content of 76, weight two pounds under average and flat foot.

The mental examination revealed a general backwardness and a psychic profile which repeatedly dipped below the median and was particularly poor in imagination, judgment and psycho-motor control. In general intelligence he ranked among those at the 0 percentile by both the Binet and the Terman scales which means one year retardation. We could hardly expect any other result with the physical condition above described. Even in the interval between the first and second operation there was practically no physical relief.

Children Nos. 13 and 14. Children Nos. 13 and 14 are brother and sister, whom we will call Sonny and Sarah. They are both fat and beaming, and it is pleasing to see the protecting air of the boy when he brings his little sister just a year younger than he is to school or to the office. The two are the youngest of five siblings. The older three are all girls and all married. The parents are both American born, of English Canadian and Scotch parentage. The father is a laborer and the pinch of poverty is reflected in the poor home and meager furnishings. They are fortunate in having a strip of ground back of the house which the father converts into a kitchen garden in the summer time. This probably accounts for the well fed appearance of the children. The mother is a strong industrious type, and the spirit of the home is splendid.

Neither of the children has had any of the usual children's diseases. Sarah is subject to croup which the mother says is "in the family." Sarah has large and diseased tonsils, enlarged cervical glands, a haemoglobin content of 75 and a slight mitral regurgitation. The left ear drum is dull; the hearing, however, is not affected. The vision is quite defective and there is in addition an incoördination of eye muscles. She is left handed. Sonny has many of the same physical difficulties. He has defective vision, enlarged tonsils, enlarged cervical glands and heart murmur. He also has enlarged

inguinal glands and needs circumcision. He has lordosis and scoliosis.

Such a list of physical defects for two children who, to a casual observer, appear particularly healthy, indicates the necessity of a thorough medical examination of all children when they first enter school.

For Sonny the Binet level is one year in advance of his age, the Stanford Revision just at age. The highest peaks in his psychological profile are attained in attention and psycho-motor ability and in resistance to suggestion; there is a decided dip in imagination and in one learning test, while the tests of the memory and of the perception group show little correlation within the group. Sarah did not make such a good showing mentally. Her intelligence rating was just at age, with both series of tests, but she dropped below the median in nineteen points in her psychic profile; she resisted suggestion well and made other good scores in some of the perception, memory and learning tests, reaching the 90 percentile in the Vital Capacity score. Both children give promise of developing into intelligent individuals, but in order to do so they need immediate medical care.

Child No. 15. Helen is seven years old, a loving and lovable child, but sadly handicapped physically and socially. She was born with a left hand that has only part of the first phalanx of all fingers and thumb. She said, with a pathetic smile, that God wished her hand to be that way. Her family is large and very poor; both her body and her clothing testify to sad neglect. The child objected so strenuously and so tearfully to the physical examination that it could not be completed. Her embarrassment was probably largely due to her uncleanly condition. Even with this incomplete examination, her list of physical defects is long—poor vision, enlarged cervical glands, rales, heart murmur, marked malnutrition, six pounds underweight, with a Vital Index below standard.

Her irregular school attendance made impossible as exhaustive a mental examination as was made of some of the children and therefore her psychic profile shows many gaps. Her intelligence level by the Binet scale and also by the Stanford Revision is just at age. Her age level for the Knox-Pintner cube test drops to the 30 percentile and for the Porteus maze test reaches the 50 percentile.

This is clearly the case of a child backward in school on account of adverse home conditions. She evidently is deprived of the

necessary food, clothing, soap and water, to say nothing of the opportunity for play and joy which are prerequisites of healthy childhood.

Enough sketches have been presented to show that the basis of physical defects and of character defects that may result in school and life failure is already fixed when the child first enters school. Enough sketches have been presented to emphasize the fact that if we desire to start the children in our schools with more equal chances of success we must reach the young mothers and must help them to an understanding of the needs of their children and of the tremendous effect on their children's lives of the habits that are formed during the first five years. The parents must be taught what to feed their children and why, when to put them to bed, and how long to keep them there. They must be made to realize that unless children see and hear clearly, breathe through their noses, have good teeth and good digestions, they need not be expected to succeed in school, or to retain their health and energy long. Parents must be taught just how to form in their children desirable habits and how to thwart undesirable habits. All this knowledge must be made vital for them, and they must be given actual aid in putting it in practice.

If educators would succeed in leading the next generation to the success of which it is potentially capable they must enter the homes and help the young parents in whose care are those first five years so important for the laying of a firm foundation of health and good habits. In order to furnish such guidance, educators must study the children during their first year in school and see to it that those who are handicapped by physical or mental defects or derangements are provided with the medical and pedagogical aid that they require.

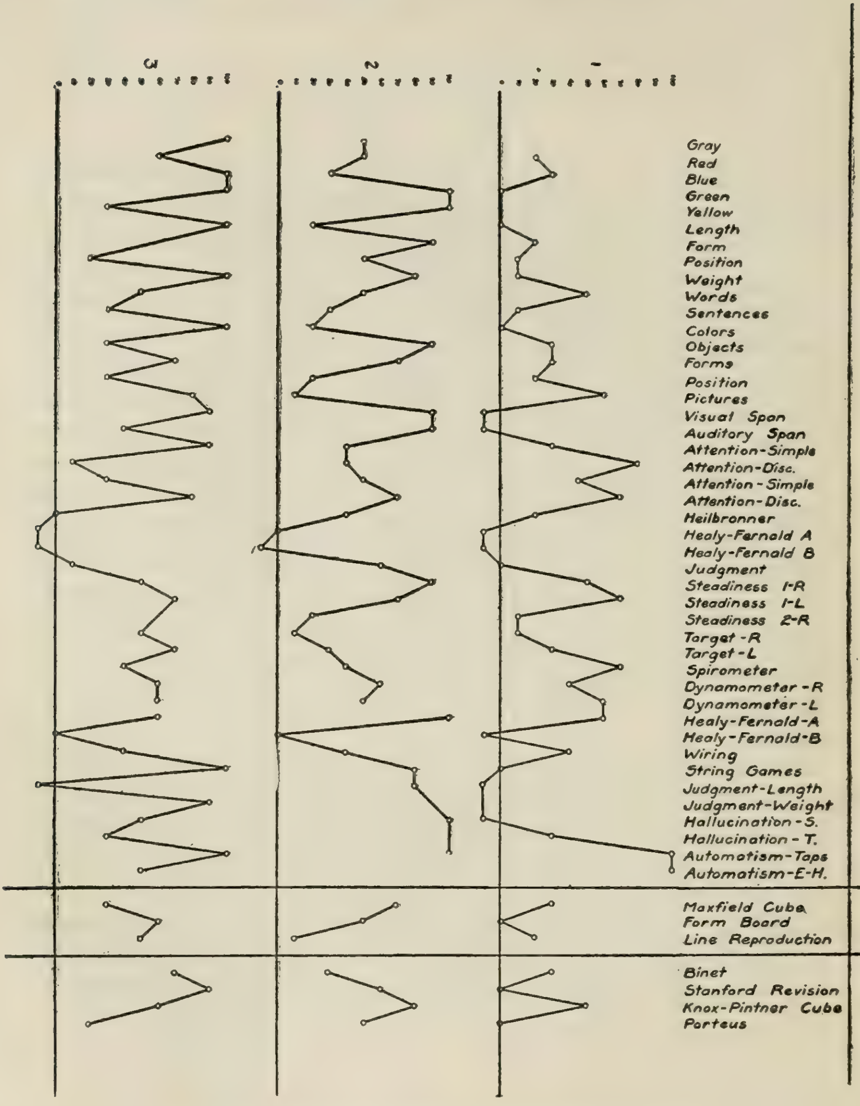


Chart III. Individual Psychological Profiles, 1-3

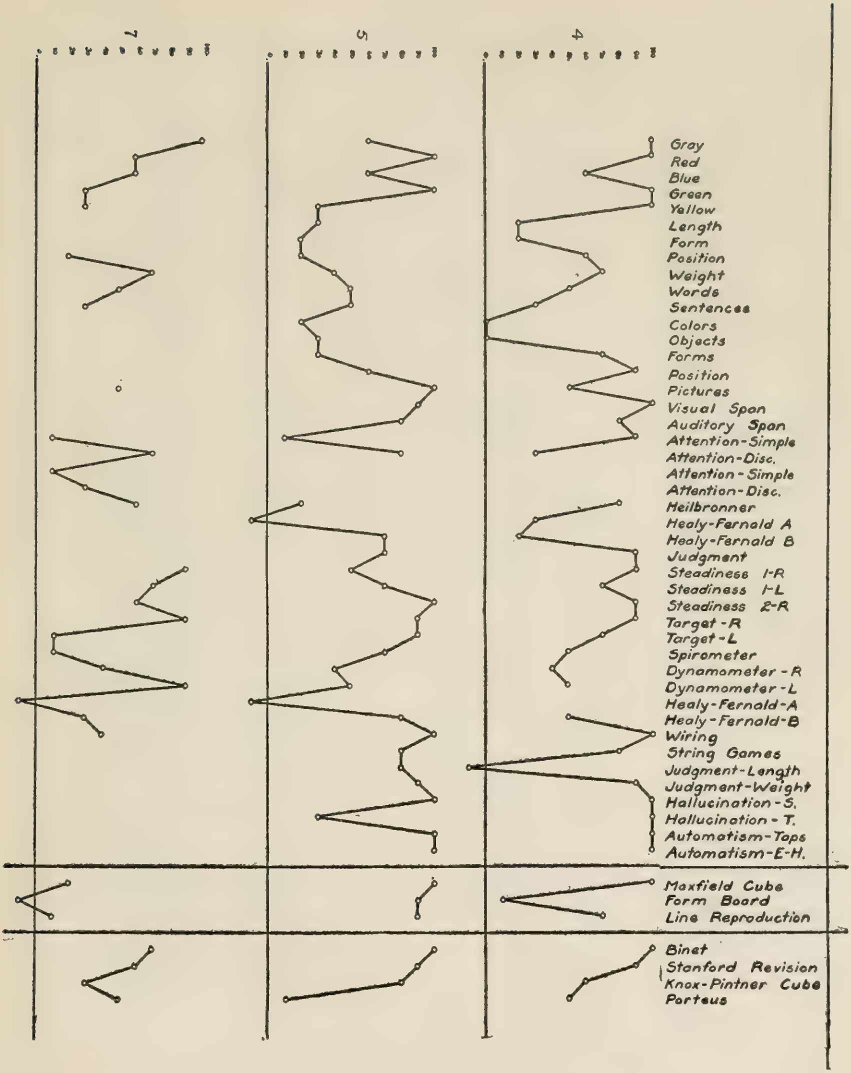


Chart IV. Individual Psychological Profiles, 4, 5, 7,

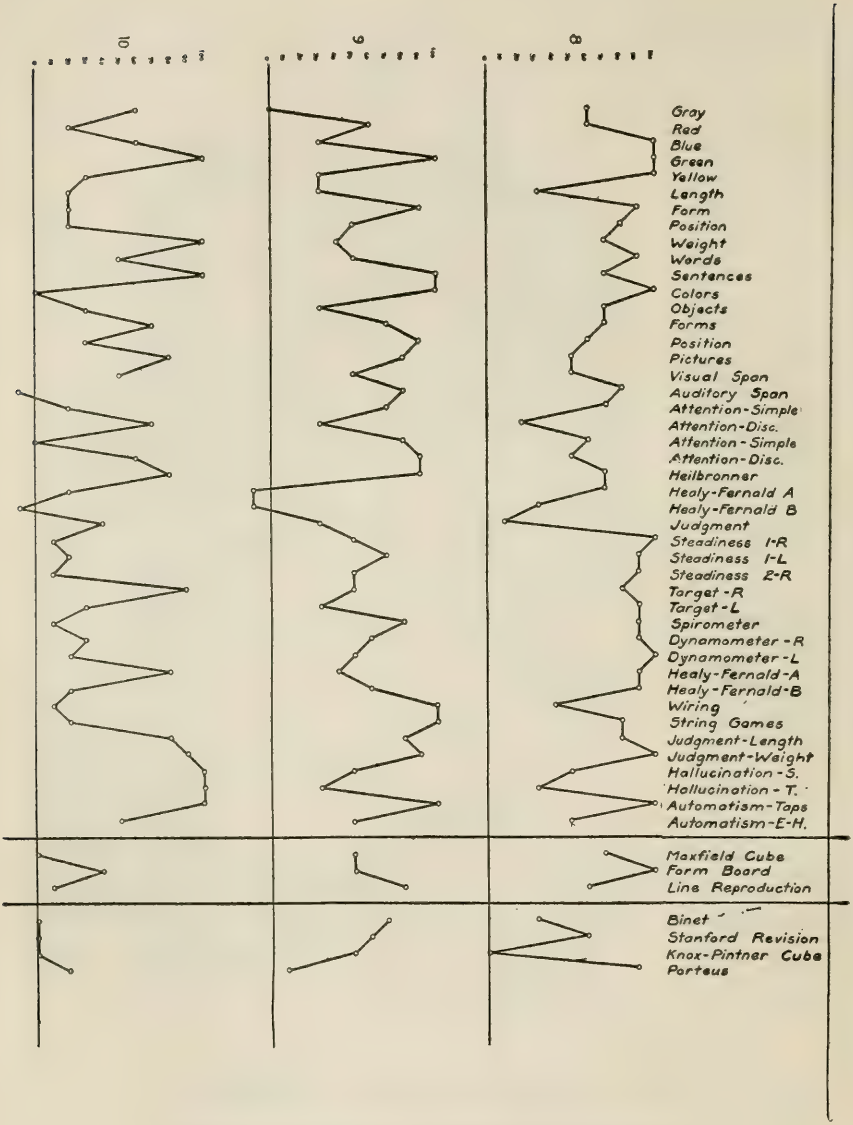


Chart V. Individual Psychological Profiles, 8-10

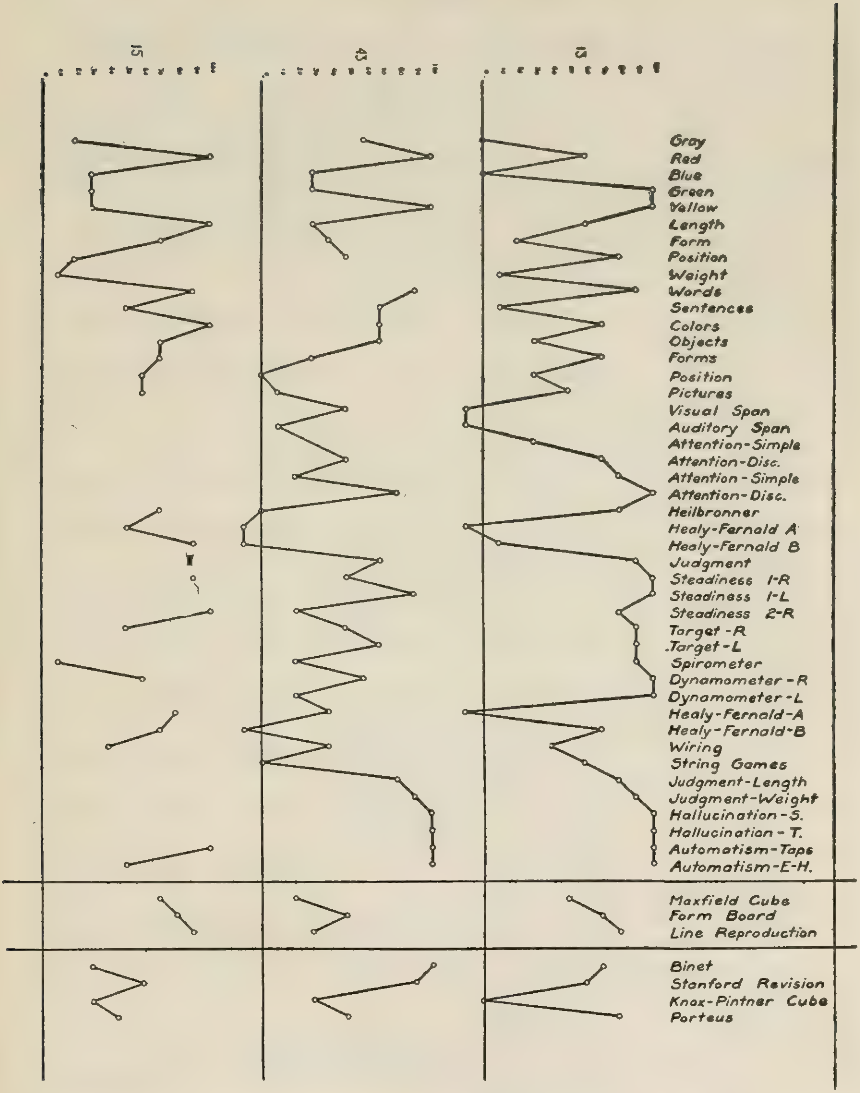


Chart VI. Individual Psychological Profiles, 13, 43, 45

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FIRST SERIES NO. 44 MARCH 1, 1921

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 5

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BY

AMY L. DANIELS
ALBERT H. BYFIELD
with the coöperation of
ROSEMARY LOUGHLIN

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 3, 1918.

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PROFESSOR BIRD T. BALDWIN, PH. D., Editor

FROM THE IOWA CHILD WELFARE RESEARCH STATION

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(Reprinted from the *American Journal of Diseases of Children*, December, 1919, Vol. XVIII, pp. 546-554; May, 1920, Vol. XIX, pp. 349-358; and from the *Journal of Biological Chemistry*, November. 1920, Vol. XLIV, No. 2, pp. 381-397.)

PUBLISHED BY THE UNIVERSITY, IOWA CITY
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EDITOR'S FOREWORD

In coöperation with the Department of Pediatrics of the College of Medicine, the Division of Nutrition of the Iowa Child Welfare Research Station has begun a series of investigations on the nutrition of infants and school children. The three papers included in this series present the results of investigations regarding the effect of the addition of materials containing the so-called antineuritic vitamin to the milk mixtures of artificially fed infants. A study has also been made of the effect of heat on the nutritional value of milk.

In the first paper, the effects of the growth stimulating value of antineuritic material obtained from wheat embryo is shown through consecutive observations in weight on six children ranging in age from one and one-half months to five months. A similar positive effect of the extract of vegetables is shown in the increments of weight of two children ranging in age from two and one-half months to four and one-half months. Vegetable soup used as a part diluent in milk showed like effects in the increase in weight of a child four and one-half months old. The second paper reports experiments showing that orange juice not only contains the antiscorbutic vitamin, but its growth stimulating properties appear to be due to the latter vitamin. The third paper gives the results from a series of experiments with animals fed *heat-treated milks*. The effects on the growth curves of rats are noted when milk is brought quickly and slowly to the boiling temperature; similar comparisons are made with diets of pasteurized, evaporated, and fresh milk.

BIRD T. BALDWIN.

Office of the Director,
Iowa Child Welfare Research Station,
University of Iowa,
Iowa City, Iowa.
January, 1921.

The Rôle of the Antineuritic Vitamin in the Artificial Feeding of Children

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AND
ALBERT H. BYFIELD, M.D.
WITH THE COOPERATION OF
ROSEMARY LOUGHLIN, M.S.
IOWA CITY, IOWA

THE RÔLE OF THE ANTINEURITIC VITAMIN IN THE ARTIFICIAL FEEDING OF INFANTS *

AMY L. DANIELS, Ph.D., and ALBERT H. BYFIELD, M.D.

WITH THE COOPERATION OF

ROSEMARY LOUGHLIN, M.S.

IOWA CITY, IOWA

From time immemorial substitutes for human milk have been sought in the mammary secretions of other animals. The inadequacy of such substitutes has been made apparent by the distinctly higher incidence of disease and death among artificially fed babies. Early attempts were directed toward the correction of the grosser difficulties. By variously modifying and diluting the substituted milks—more particularly cow's milk—these have been rendered more acceptable to the digestion and quantitative needs of the infant. As a result, artificial feeding in the hands of the skilful worker has been fairly successful if measured in terms of disease and death. But so concerned have we been with the more obvious disturbances that little attention has been paid to the possible deficiencies of these diluted milks which may render them greatly inferior to human milk as far as their growth promoting factors are concerned, although experience has taught that the addition of other substances to the milk diet has been found to be not only desirable but necessary as early as the sixth month.

While students of nutrition have for some time been awake to the importance of the antineuritic vitamin as an essential factor in growth and physiologic well being, with the exception of cases of beriberi, there has been little consideration of a possible relationship between this growth factor and nutritional disturbances in infancy. The reason for this is possibly due to the fact that a paucity of this material produces such subtle changes that the interest of the pediatrician has not been drawn to them, especially since until very recently we have believed milk to be a valuable source of this food accessory.

That milk is comparatively low in the antineuritic vitamin has been pointed out by both Gibson and Concepcion[1] and Osborne and Mendel.[2] The former investigators, working with dogs and pigs

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* From the Department of Nutrition, Iowa Child Welfare Research Station and the Department of Pediatrics, State University of Iowa.

1. Gibson, R. B., and Concepcion, I.: Philippine J. Sc. B. **11**:119 (May) 1916.
2. Osborne, T. B., and Mendel, L. B.: J. Biol. Chem. **34**:537 (June) 1918.

on problems pertaining to infantile beriberi, found that the addition of milk to diets consisting largely of polished rice did not protect against symptoms of polyneuritis, a disease which is known to be caused by a lack of this food accessory; while Osborne and Mendel demonstrated its low concentration through feeding experiments with rats, where milk was the sole source of the vitamin. Both groups of investigators have suggested that some of the difficulties in artificially fed babies may be due to an insufficient amount of the vitamin material. Indeed, Gibson and Concepcion believe that even in breast fed babies the diet should be extended as soon as possible. These state that "The young of healthy mothers probably come into the world with a reserve supply of the vitamin substances sufficient to tide them over nutritively until the time when under natural conditions of life they begin to eat other foodstuffs." If this is true of the breast fed baby, how much more important it is that the diet of the arificially fed baby be scrutinized with this in mind. To quote Osborne and Mendel[3]: "A particular case of this kind is that of infant feeding where it is customary to reinforce the supply of calories by diluting top milk and adding milk sugar. Under these circumstances the child is supplied with a food that contains a relatively smaller proportion of the water soluble vitamin than does the original cow's milk. While milk thus modified may contain sufficient vitamin as long as the food intake is normal, if for any reason the child's appetite fails, the vitamin supply is reduced and endless dietary troubles may easily result."

In a study of the weight charts of the babies in our clinic it was observed that in order to get adequate gain in weight it was necessary to give considerably more food than when breast milk is used. Whereas 100[4] calories per kg. is considered sufficient for breast fed babies under 6 months of age, and 90 calories for those more than 6 months old, our babies were receiving from 120 to as high as 150 calories per kilogram on their "theoretical"[5] weight. This experience apparently is borne out by other workers,[6] although these authors do not state whether or not they have based their requirements on the theoretical or the actual weights.

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3. Osborne, T. B., and Mendel, L. B.: Loc. cit.

4. Langstein, L., and Meyer, L. F.: Säuglingsernährung und Säuglingsstoffwechsel., 2d Ed., Wiesbaden, 1914, p. 98.

5. The following adaptation of Finkelstein's rule was used in estimating the theoretical weight: Birth weight + (600 times age in months) — 300 = weight for the first six months. Birth weight + (500 times age in months) = weight for the second six months.

6. Morse, J. L., and Talbot, F. R.: Diseases of Nutrition and Infant Feeding, New York, The Macmillan Co., 1915, p. 185. Hess, J. H.: Principles and Practice of Infant Feeding, Philadelphia, F. A. Davis Co., 1918, p. 148.

The cases considered were all normal babies many of whom had been in the clinic from the eighteenth day. The feedings consisted of milk mixtures approximating the composition of mother's milk. The dilution system of modification was used, cream and one or more of the usual carbohydrates being added, with sometimes cereal diluents. In all cases the milk preparations were either pasteurized, or boiled one minute in an open kettle. With these mixtures in such liberal quantities, eminently satisfactory gain was achieved, for it was the custom when the child failed to gain to give as much food as was necessary to obtain a normal growth curve. Scurvy was protected against by one-half ounce of orange juice given daily.

If milk is, as suggested, deficient in the antineuritic vitamin it is possible that the large caloric requirement of our babies may be explained by the fact that the additional food, beyond that necessary to meet the needs when breast milk is fed, carried enough of this essential material by adsorption to supply the needs of the child. McCollum[7] and co-workers found in feeding experiments with rats that when the 20 per cent. of lactose used in their purified ration was replaced by an equal amount of dextrin, no growth was secured. These authors attribute their results to a lack of the antineuritic vitamin which had been introduced into the ration with the lactose. Observations, therefore, on the effect of the addition of materials known to contain the antineuritic vitamin were made. During the ward walk those children who were not gaining were selected for a study of the influence of the antineuritic vitamin, without regard to the calory value of the food intake. These babies were receiving from 104 to 126 calories per kilogram on their actual weights and from 90 to 130 calories on their theoretical weights. In each case from one to three periods of vitamin additions were made to the diets, with intervals of about ten days between each. The length of the periods during which the material containing the antineuritic vitamin was added varied from ten to twenty days.

In the first series the antineuritic material was obtained from wheat embryo, the method of extraction being the same as that used in studies pertaining to its influence on growth in animals (rats) fed purified rations. One hundred and eighty gm. of the embryo were extracted with 95 per cent. alcohol for from forty-eight to ninety-six hours. After filtering, 50 c.c. of water were added, the alcohol was distilled off, and the residue made up to 500 c.c. with distilled water. This vitamin containing mixture when tested with Fehling's solution caused a slight reduction; the addition of Lugol's solution produced a faint violet cloud. Subsequent hydrolysis yielded

7. McCollum, E. V., and Davis, M.: J. Biol. Chem. **20**:641, 1915.

a fluid which contained 2.3 per cent. of reducing sugars.[8] Since 50 c.c. were used in each day's feeding the amount of carbohydrate added was equivalent to approximately 1 gm., not enough to affect the growth curve materially.

In a second series (Chart 6) the influence of the alcoholic extract of those vegetables—carrots, turnips and celery— which were used in preparing the vegetable soup referred to below was tested. The vegetables were comminuted, dried in a current of air and treated in the same way as the wheat embryo. The residue of the alcoholic extract of 675 gm. (fresh weight) of vegetable was dissolved in 500 c.c. of distilled water. This mixture contained less than 1 per cent. of reducing sugars. In certain instances 50 c.c. of this were added to a day's feeding, in others, 80 c.c.

DISCUSSION OF RESULTS

It will be seen from a study of the charts that when the vitamin containing extracts were added there was a similar gain in weight in all cases, in spite of the variable factor, such as age, the caloric value of the food and the somewhat different percentage composition of the mixtures fed. In the five charts (Charts 1, 2, 3, 4 and 5) showing the results of the wheat embryo additions, the ages of the children varied from 1½ to 5 months. A similar stimulation of growth took place in older chldren to whose diet the antineuritic vitamin was added. But since the food conditions in these were not constant, frequently including slightly variable amounts of cereals, their growth curves have not been included.

Apparently the caloric value of the food had little influence on our results, for the food ingestion per kilogram on the actual weight varied between 100 and 120 calories and between 88 and 130 calories on the theoretic weights. Furthermore, in Chart 5 it will be observed that in the same baby the caloric value of the food per unit of weight diminished with the increase in weight, while the growth stimulating influence of the added material was uniform during the periods studied. At the beginning of the investigation this baby (Dorothy G.) was receiving 120 calories on her actual weight, whereas at the beginning of the third period of vitamin addition she was receiving only 100 calories on her actual weight.

In Chart 4 we were able to demonstrate that the slight carbohydrate content of the antineuritic extracts obtained from both the wheat embryo and the vegetables was without influence. The addition of 7 gm. of dextri-maltose did not materially affect the growth curve

8. Benedict, S. R.: J. A. M. A. **57**:1193 (Oct. 7) 1911.

in this case (Jean M.) When, however, the antineuritic vitamin containing extract was added there was a stimulation of growth which apparently was otherwise not possible, for growth had become stationary on the very low food intake—88 calories per kilogram on her theoretical weight—which this baby was receiving at this period.

It is appreciated that if the daily addition of an antineuritic material must be made to the diet of the artificially fed baby some

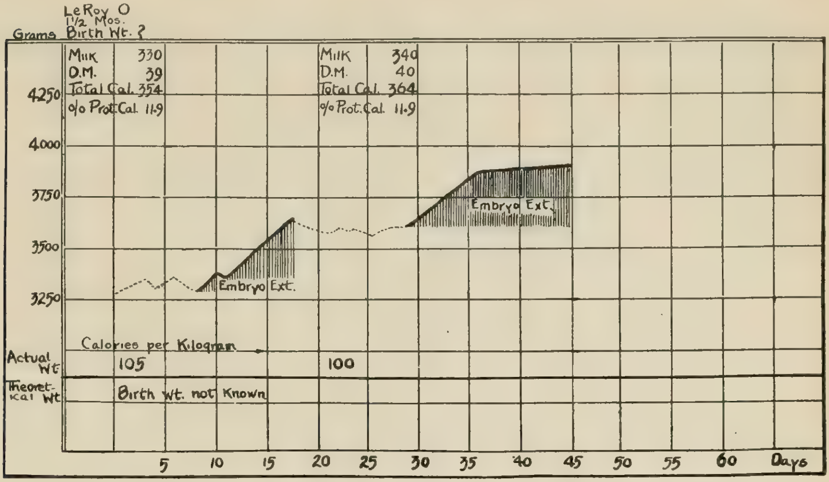

Fig. 1.—The influence of addition, withdrawal and second addition of the wheat embryo extract.

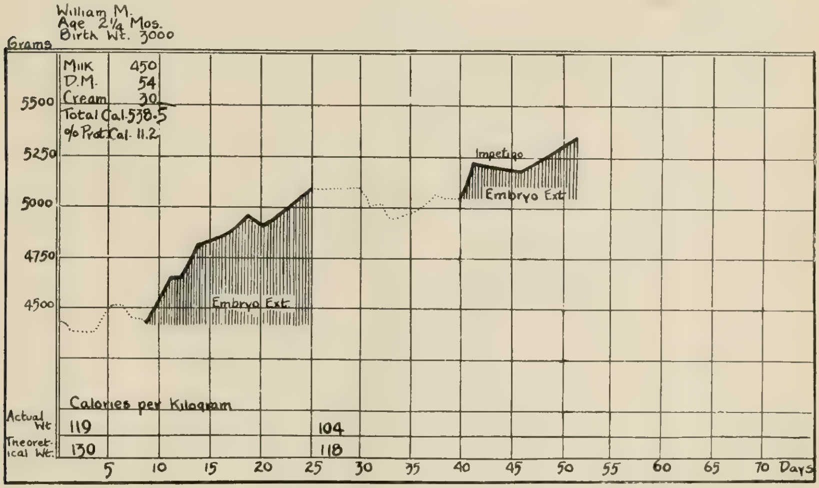

Fig. 2.—When the caloric food intake is considerably above the average, growth stimulation by the embryo extract appears to be somewhat greater. (See Chart 4.)

more easily available source than the wheat embryo extract must be found. Vegetables naturally were first thought of in this connection; and in Charts 6 and 7 are shown curves which demonstrate that the antineuritic material contained in these is a possible source when given in sufficient quantity. In the case of Harriet B. (Chart 6) a slight gain was achieved when 50 c.c. of the prepared vegetable extract were used; and a still more characteristic increase when 80 c.c.

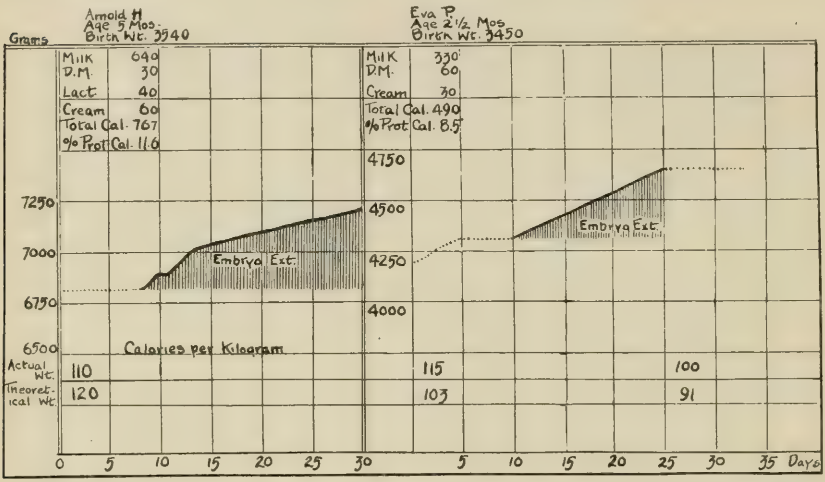

Fig. 3.—Stimulation of growth brought about by the daily addition of the wheat embryo extract following periods of practically stationary weight.

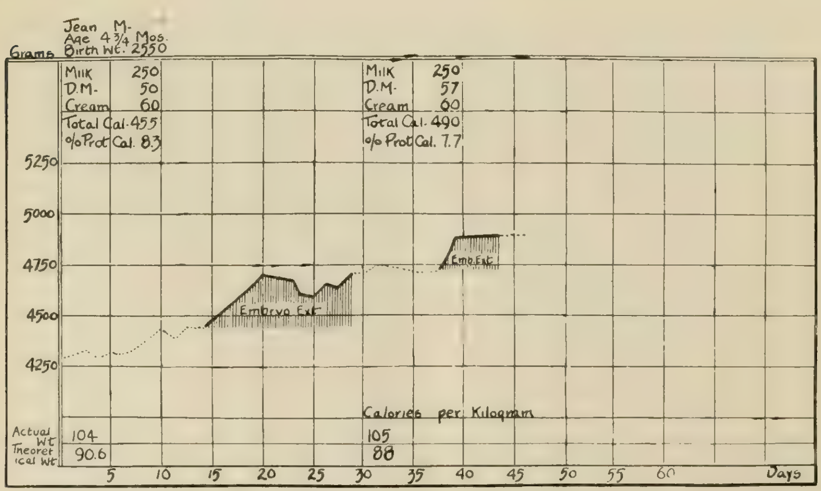

Fig. 4.—With smaller caloric intake—less than 95 per kg.—wheat embryo extract has a lesser influence in bringing about weight increases. The addition of 7 gm. of carbohydrate (28 calories) was without influence on the weight curve.

were included in each day's diet, the material being added to the bottle feedings.

Since our preparations of the antineuritic vitamin are not feasible in routine infant feeding, a special vegetable soup was substituted for the extracted material, and used as a part diluent in the milk formula. This was made of 227 gm. of turnips, 278 gm. of carrots and 170 gm. of celery. These were comminuted and cooked until

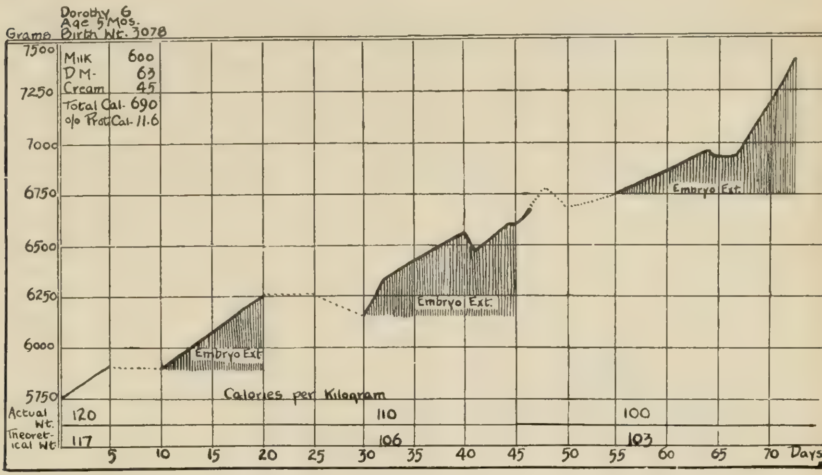

Fig. 5.—Favorable influence of wheat embryo extract addition during three successive periods.

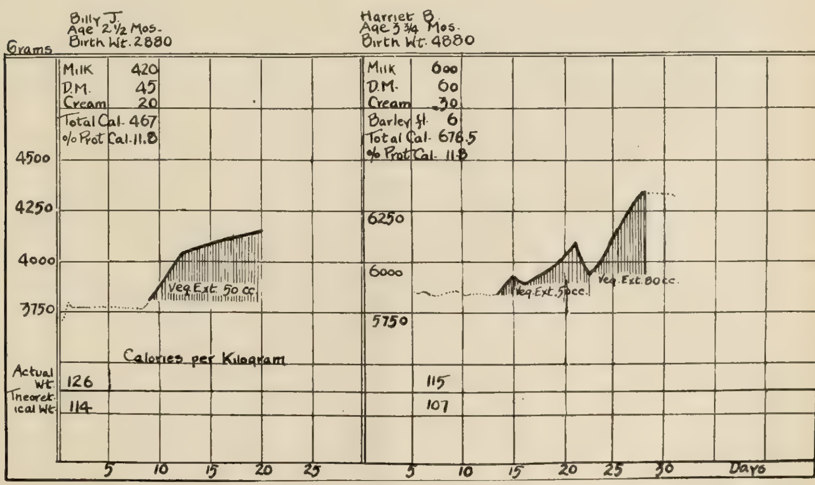

Fig. 6.—The alcoholic extract of vegetables had an influence similar to that of the wheat embryo extract. In the case of Harriet B., 80 c.c. seemed somewhat more efficient than 50 c.c.

very soft, with enough water to cover. The material was then strained, thereby removing practically all of the cellular material. From the 675 gm. of fresh vegetables there was obtained 500 c.c. of soup.

In Chart 7, 50 c.c. of this vegetable soup were found to be insufficient. When double this amount was added growth was markedly stimulated. With the use of the vegetables, it is appreciated that another factor has been introduced, namely, that of the inorganic salts. What part these salts play in the growth curve and what their effect on the child is, remains to be determined. There is no doubt, however, that at least a part of the growth stimulation has been due to the antineuritic vitamin.

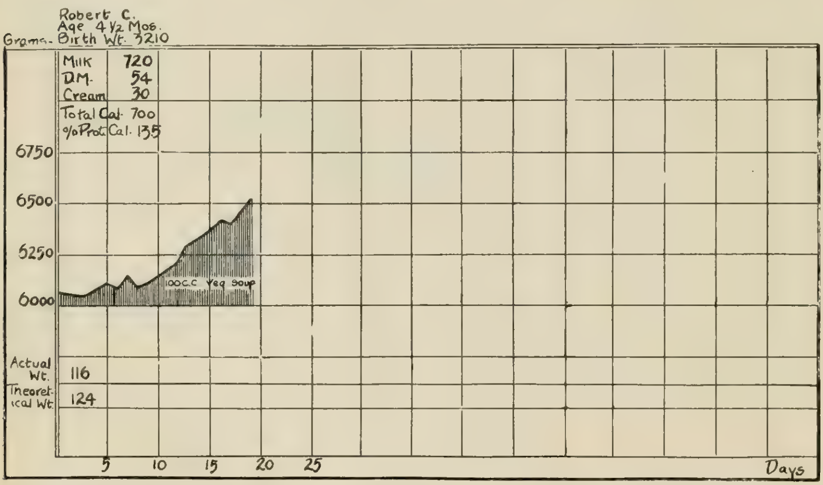

Fig. 7.—Vegetable soup used as part diluent in the milk modification also stimulated growth. During the first part of the investigation period 30 c.c. were added, whereas during the second part 100 c.c. were used.

It should be borne in mind that the infants reported here have all been normal babies and therefore their antineuritic requirements were presumably small. However, this should not affect the validity of the findings for in other cases in which this substance has been added where there was manifestly under nutrition, growth has been stimulated. Since other therapeutic measures were included in the treatment of these cases it has not seemed pertinent to include their charts in this report. Our results here are comparable apparently to those of Eddy and Roper[9] who found that the antineuritic vitamin obtained from pancreas stimulated growth in children suffering from marasmus.

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9. Eddy, W. H., and Roper, C. J.: Am. J. Dis. Child. **14**:189 (Sept.) 1917.

The influence of the addition of the antineuritic vitamin on the growth of older children has been indicated by Hess.[10] In studies pertaining to infantile scurvy, a cereal composed of wheat middlings and farina was used. "In certain instances," he states, "improvement was immediate and striking; there was a gain in weight for the first time in many months." The effect of this material, however, was in no way comparable to that produced by the addition of orange juice. It is probable that Hess' babies were suffering from a lack of the antineuritic as well as the antiscorbutic vitamin. In a later attempt to find a substitute for orange juice as an antiscorbutic, Hess[11] in turn used both yeast and wheat germ preparations. While his work indicated that these apparently have no antiscorbutic value, when they were added to the diet of some older babies and children from 1½ to 2 years old, there was marked stimulation of growth. It would appear these children also had been receiving a diet furnishing too little of the antineuritic vitamin.

CONCLUSIONS

From the results of the investigation it would seem that the following conclusions are justified:

1. The addition of the antineuritic vitamin obtained from wheat embryo to the diet of babies supplied with food furnishing an adequate number of calories stimulated growth.

2. The beneficial influence of adding a specially prepared vegetable soup in sufficient quantity as part diluent in the milk modifications for infants is apparently due to the presence of the antineuritic vitamin contained therein. Both the alcoholic soluble material of the dried soup vegetables, and the water extract (soup) stimulated growth.

3. The fact that the artificially fed infant requires a larger amount of food than the breast fed infant appears to be due to the relative paucity of diluted cow's milk in the antineuritic vitamin.

4. It is probable that failure to gain in infants and young children is often the result of an insufficient amount of the antineuritic vitamin in the food. The diets of the young, we believe, should be more carefully scrutinized with this in mind.

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10. Hess, A. F.: J. A. M. A. **65**:1003 (Sept. 18) 1915.
11. Hess, A. F.: Am. J. Dis. Child. **13**:98 (Jan.) 1917.

Reprinted from the American Journal of Diseases of Children
December, 1919, Vol. XVIII, pp. 546-554

American Medical Association
Five Hundred and Thirty-Five North Dearborn Street
CHICAGO

THE ANTINEURITIC AND GROWTH STIMULATING PROPERTIES OF ORANGE JUICE *

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WITH THE COOPERATION OF

ROSEMARY LOUGHLIN, M.S.

IOWA CITY

Orange juice has been so universally regarded as an antiscorbutic, that its other possible properties as affecting the well-being of artificially fed infants have not received much consideration. This, perhaps, is to be expected in view of the fact that the daily giving of orange juice is comparatively recent.[1] Orange juice has been widely used as a mild cathartic for infants and young children, its potency having been assumed. Recently, Gerstenberger [2] has pointed out that there is no experimental basis for this, and states that, on the contrary, orange juice tends to constipate. The diuretic property of orange juice has been noted by Gerstenberger,[3] and again by Hess.[4] Orange juice was the chief constituent of a fruit mixture used by Gladstone [5] in treating certain cases of marasmus. This mixture, of which he used a surprisingly large amount—24 ounces a day—consisted of 2 parts of orange and 1 part apple juice with a small amount of water. According to the author's report, this was enjoyed by all babies, who soon became less restless and irritable, but did not gain in weight until a suitable milk modification was given. The good results were attributed to the "tonic cleansing effects on the mucous membranes" and to the "diuretic, diaphoretic and general alterative properties" of the mixture. Kohlbrugge [6] has reported the benefits following the administration of orange juice in cholera infantum.

The therapeutic effects of the addition of orange juice to the diets of infants suffering from scurvy has been studied by Hess.[7] Accord-

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1. Hess, J. H.: Principles and Practice of Infant Feeding, Ed. 2, Philadelphia, 1919, p. 156. Hill, L. W., and Gerstley, J. R.: Clinical Lectures on Infant Feeding, Philadelphia, 1917, p. 160. Morse, J. L., and Talbot, F. B.: Diseases of Nutrition and Infant Feeding, New York, 1915, p. 233.
2. Gerstenberger, H. J., and Champion, W. M.: Am. J. Dis. Child. **18**:88 (Aug.) 1919.
3. Gerstenberger, H. J.: Am. J. M. Sc. **155**:253 (Feb.) 1918.
4. Hess, A. F.: Am. J. Dis. Child. **14**:337 (Nov.) 1917.
5. Gladstone, H. B.: Practitioner, London **97**:472 (Nov.) 1916.
6. Kohlbrugge: Centralbl. f. Bakteriol. **60**:223 (Part 1) 1911.
7. Hess, A. F.: J. A. M. A. **75**:1003 (Sept. 18) 1915. Hess, A. F.: Am. J. Dis. Child. **12**:152 (Aug.) 1916.

ing to him, some of the symptoms of infantile scurvy appear to bear a close relationship to the deficiency diseases—more particularly beriberi; for besides the usual signs and hemorrhagic symptoms of scurvy, he found such others as tachycardia, dilation of the heart and failure to gain. When orange juice was given, not only did the usual scurvy symptoms disappear, but the children gained in weight and the cardiac signs became normal. The omission of the orange juice was followed by a period of stationary weight until it was again added to the diet. These gains the author attributed to the effect of the antiscorbutic material. In the reports, unfortunately, there are not sufficient data to determine the caloric value of the food given or to indicate its content of growth promoting material. Those children who continued to gain in spite of scorbutic symptoms may have been receiving more food or food supplying more of the antineuritic vitamin.[8] Our previous work showing the influence on growth of the addition of this vitamin to the diet of babies led us to suspect that Hess' weight gains following the addition of orange juice might be owing to the presence of antineuritic material in the orange juice, rather than to the antiscorbutic material.

Hitherto, oranges, and fruits in general, although valuable antiscorbutics, have not been regarded as sources of the antineuritic vitamin. The literature contains no mention of them in the treatment of beriberi, and with the exception of the banana and the tomato, so far as we have been able to find, there have been no experiments indicating their antineuritic properties.[9] The present state of our information on this point is suggested by the following quotation from Harden and Zilva:[10] "We have so far not come across a natural product which contained both the antiscorbutic and the antineuritic vitamins in quantities suitable for investigation." In order to obtain a mixture containing both vitamins, these investigators added autolyzed yeast to orange juice to supply the antineuritic material.

Since the antineuritic value of oranges had not been determined, it seemed pertinent to study them from this standpoint, especially in respect to their influence on growth. In our clinic, a series of observations were carried out on babies under the same conditions as those reported in a previous communication.[11] With one exception, the diet of the infants was constant throughout the various periods, the intake per kilogram being computed both on the theoretical and actual

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8. We shall use the term "antineuritic" vitamin, recognizing the fact that this may include more than one substance as suggested by Mitchell, H. H.: J. Biol. Chem. **11**:399 (Dec.) 1919.

9. Daniels, A. L., and Byfield, A. H.: Am. J. Dis. Child. **18**:546 (Dec.) 1919

10. Harden, A., and Zilva, S. S.: Biochem. J. **12**:93 (June) 1918.

11. See Note 9.

weights. The milk mixtures were "sterilized" by boiling one minute in an open kettle. In all cases these babies had been receiving from the first month a daily dose of 15 c.c of orange juice — the customary amount given in this clinic. From preliminary studies of the influence of orange juice on the growth of rats, it was roughly estimated that 45 c.c. of orange juice should stimulate growth. Accordingly, this amount, properly diluted, and sweetened with a few drops of a saccharin solution, was given, one half in the morning and one half in the afternoon, to those infants whose weight had remained stationary for a number of days. For some days previous, and during the observation periods, both the food and the orange juice were prepared by one of us (A. L. D.).

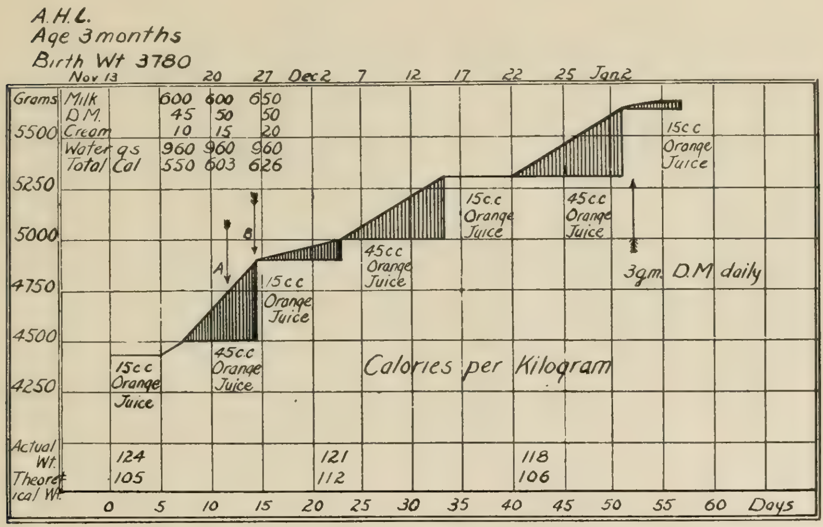

Fig. 1.—A. H. L. Three separate orange juice additions in a period of sixty days gave uniform weight increases. During Period 1, an increase in the food produced no corresponding increase in weight. When the usual quantity of orange juice (15 c.c.) was given at B, a second increase in food was made. The effect of the two food increases was distinctly less than that produced by the larger quantity of orange juice.

It will be noted that in every case when the amount of orange juice was increased from 15 c.c. to 45 c.c. per day, there was a marked stimulation of growth. When the amount of orange juice was reduced to the 15 c.c., the weights again became stationary. The longest observation was in the case of A. H. L. (Fig. 1), three separate orange juice periods being included. During period one it was necessary to increase the amount of food, owing to the fact that the baby was extremely hungry and restless. A food increase of fifty-three calories had no apparent influence on the rate of gain. The day after the orange juice

was removed, the food was again increased by twenty-three calories. This produced only a slight gain (100 gm. in ten days), and was in no way comparable to that produced by the orange juice (250 gm. in five days). The subsequent addition of orange juice during a period of nine days resulted in an increase in weight of 300 gm. A second decrease in the amount of orange juice was again followed by a stationary weight period. A third addition of the larger amount of orange juice stimulated growth as before. The weight curves of the other babies show similar results, and are comparable to those of our earlier work in which it was shown that under similar conditions growth was stimulated by the addition to the milk formula of the antineuritic vitamin obtained from the wheat embryo extract.

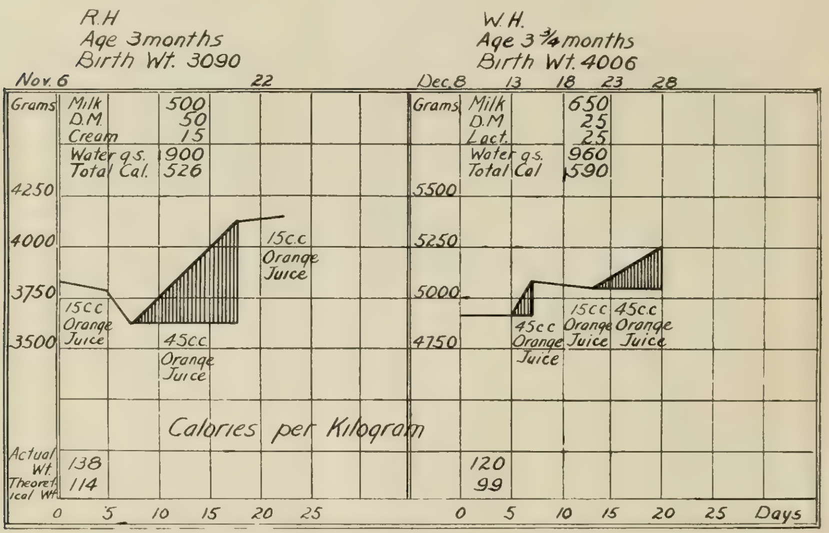

Fig. 2.—R. H. and W. H. The addition of 45 c.c. of orange juice per day produces an average daily weight gain of 40 gm. in the case of R. H.; with W. H. the immediate effect of the addition of orange juice during ten days is shown. A reduction to 15 c.c. produced a stationary weight.

Seidell,[12] and later, Harden and Zilva [13] have shown that the antineuritic vitamin may be removed quantitatively from a substance containing the two vitamins by adsorption, either with Lloyd's reagent or fuller's earth, the antiscorbutic material remaining unaffected. Accordingly, in our work the expressed juice (80 c.c.) of the orange was shaken with 15 gm. of kaolin for twenty minutes and filtered. When 45 c.c. of this filtrate per day were given to the babies there was no increase in weight (Figs. 3 and 4). In the following period, however.

12. Seidell, A.: U. S. Public Health Rep. **31**:366, 1916.
13. See Note 10.

when an equal quantity of *untreated* orange juice was given, there was an immediate gain in weight. From these results it appears that the growth stimulating factor had been removed by the kaolin.

That orange juice contains a growth stimulating material is further evidenced by the fact that rats fed a purified ration, with orange juice as the sole source of the antineutritic vitamin, grew normally, although a larger amount (75 c.c. per 100 gm. of ration) was necessary to produce the same rate of gain as when our wheat embryo extract was used (25 c.c. per hundred grams of ration) (Fig. 5, Group I). This was not due to the antiscorbutic vitamin because other rats receiving orange juice which had been boiled for five minutes with an excess of a 2 per cent. solution of sodium hydroxid (to destroy the antiscorbutic

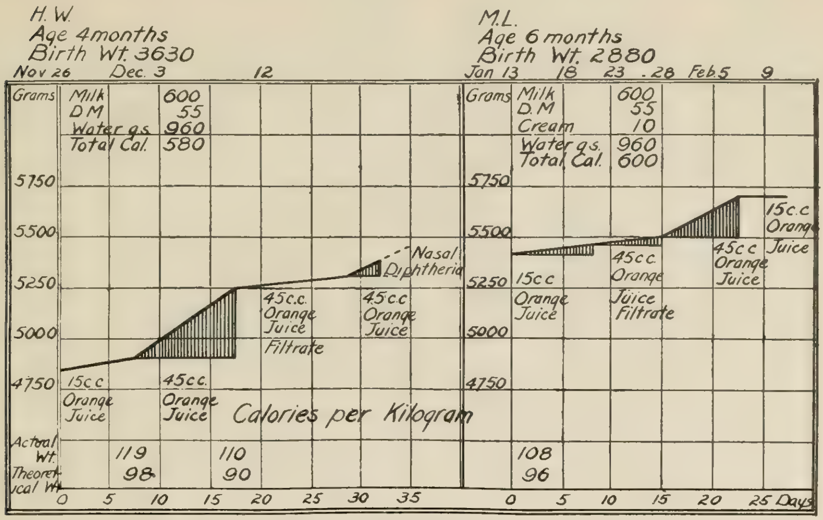

Fig. 3.—Both curves show the comparative influence of the lesser amount of orange juice (15 c.c.), the filtrate of the kaolin treated orange juice (45 c.c.) and of the large amount of untreated orange juice (45 c.c.).

vitamin) grew quite as well as those receiving the untreated orange juice (Fig. 5, Group 2). Furthermore, the addition to a purified ration of the kaolin residue from the orange juice produced a prompt resumption of growth in other animals in which the orange juice filtrate had failed to secure growth (Fig. 5, Group 3, Period 2).

That orange juice contains a considerable quantity of the antineuritic vitamin was also shown by its effect on polyneuritic pigeons. These birds, previously fed polished rice for from twenty-one to thirty-seven days, developed typical polyneuritis, manifested by the classical symptoms — muscular weakness, retraction of the neck, and paralysis of the muscles of deglutition. One of these pigeons, suffer-

ing from almost complete paralysis of respiration, was quite restored by the next morning, after the subcutaneous and oral administration of orange juice on the previous evening. The orange juice, which was injected subcutaneously, was made neutral with sodium hydroxid and sterilized.

The difference in the curative effect of the treated and untreated orange juice was strikingly brought out in two polyneuritic pigeons. One bird, receiving daily 10 c.c. of the untreated juice, recovered in twenty-four hours and showed no polyneuritic symptoms thereafter; the other pigeon, which was given each day 10 c.c. of the filtrate from the kaolin treated orange juice died after four days. A fourth polyneuritic pigeon became so weak that when placed on its side it could

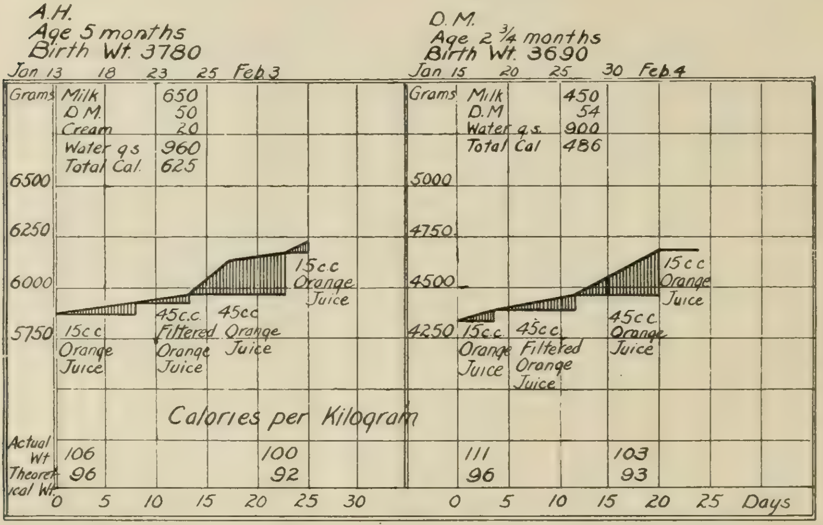

Fig. 4.—The curves also illustrate the difference between the effect of the removal of the antineuritic vitamin from orange juice.

not resume the upright position. It was given 10 c.c. of untreated orange juice by mouth. The next morning the bird was up and about, and apparently quite normal. At the necropsy, the polyneuritic pigeons were found to have full crops and dilated hearts. Some pericardial fluid was present.

To determine the effect of the filtrate from the kaolin treated orange juice, a series of observations were made on both rats and guinea-pigs. Rats (Fig. 5, Group 3, Period 2), fed a purified ration to which this filtrate previously neutralized was added, made no growth, although the amount used was equal to that of the groups fed the untreated and alkalinized orange juice. Guinea-pigs in which scurvy had been produced by a prolonged diet (sixty days) of oats and 40 c.c. of super-

heated milk (100 C. for one hour) per day were cured by the addition of 5 c.c. per day of the filtrate of the kaolin treated orange juice. These facts lead us to conclude that orange juice shaken with kaolin and filtered loses its growth stimulating property, while its antiscorbutic potency is not impaired. Our results, here, are in keeping both with our observations on babies and with the work of Harden and Zilva.

DISCUSSION

The results obtained by the addition of orange juice to or omission from the diet of babies were uniform and constant. Under the conditions maintained, growth, as evidenced by the weight curves, was in all cases stimulated when orange juice was given. On the other hand, orange juice from which the antineuritic vitamin had been removed was without influence. The fact that the changes produced were usually apparent within a day made the results more significant. That

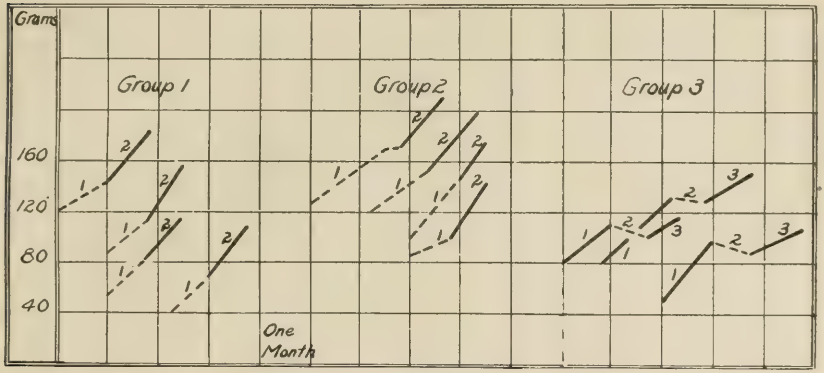

Fig. 5.—This shows the effect on the growth of rats of the addition of the treated and untreated orange juice to a purified ration otherwise complete but lacking the antineuritic vitamin. The ration consisted of 18 per cent. casein, 5 per cent. butter, 23 per cent. lard, cornstarch 46.79 per cent., and 7.03 per cent. of a suitable salt mixture. During Period 1, Group 1, the ration contained 55 c.c. of orange juice per hundred grams of ration; during Period 2, 75 c.c. of orange juice were used. Group 2 was given the alkalinized orange juice, 55 c.c. being added to the purified ration during Period 1, and 75 c.c. during Period 2. During Period 1, Group 3 was given the purified ration in which our wheat embryo extract (25 c.c. per hundred grams) was the sole source of the antineuritic vitamin. In Period 2, 75 c.c. of the filtrate from the kaolin treated orange juice was added to the purified ration. During Period 3, the source of the antineuritic vitamin was the kaolin residue of the shaken orange juice.

other constituents of the orange juice, for example, the carbohydrates, apparently played no part in our results is shown in the case of A. H. L. Dietary increases, both during and after an orange juice period, were without marked effect. Furthermore, the addition of 3 gm. of sugar

— dextri-maltose — an amount equivalent to the sugar content of the orange juice of the previous period was also without appreciable effect (Fig. 1). In certain instances the gains were less marked than in others, the greatest gains being made in those babies receiving the most food based on their theoretical weight. If the caloric intake per kilogram—that is, kilogram of estimated weight—fell to ninety or thereabout, there was less stimulation. This is shown in Figure 4.

Up to the present time studies dealing with the influence of the antineuritic vitamin on growth have not shown whether the weight increases were due to the stimulation of appetite, and thus an increased ingestion of food, or to the direct influence of the antineuritic vitamin on metabolism.[14] While not attempting to solve this problem, we have watched our children with this point in mind. In no case was a loss of appetite apparent, the same amount of food being taken during the entire experimental period. In animal experiments the conditions are quite different; for in these considerably less than the minimal requirement of the antineuritic vitamin is usually given for a much longer time. Under these conditions the appetite is greatly diminished; when the antineuritic vitamin, therefore, is added, the effect on the appetite is marked. In our babies' diet, however, a considerable amount of this essential growth constituent was always present, and, therefore, the appetite factor did not seem to enter into consideration. Furthermore, we recall the paralyzing influence of the polished rice diet on the gastro-intestinal tract of the polyneuritic pigeons and wonder if it is not this phenomenon which in animal experiments, in part, at least, is responsible for the anorexia. In general, it appears that the appetite factor plays only a minor rôle in the stimulating effect of the water soluble vitamin on growth, provided a nearly adequate amount is being given.

The question as to whether the antiscorbutic vitamin has growth stimulating properties has not been the subject of extensive experimentation. All authors agree that there is a loss of weight in experimental scurvy, especially as the manifestations become more distinct. There is, however, a corresponding loss of appetite which may be responsible for this. To be sure, in the many observations made by Hess, a failure to gain in children was usual; and in the early stages of the disease, at least, there was no actual loss in weight. Harden and Zilva,[15] and Drummond[16] have reported that rats fed a purified ration to which a small amount of orange juice was added as an antiscorbutic made better gains than others similarly fed but without the

14. Osborne, T. B., and Mendel: J. Biol. Chem. **37**:187 (Jan.) 1919.
15. Harden, A., and Zilva, S. S.: Biochem. J. **12**:408 (Dec.) 1918.
16. Drummond, J. C.: Biochem. J. **13**:77 (May) 1919.

orange juice. They concluded from their work that the antiscorbutic vitamin was essential to the well-being of animals, as manifested by the better weight gains of the rats receiving it. This suggests that the antiscorbutic vitamin has growth stimulating properties. Our own observations on babies, however, fail to bear this out.

At the present time there is little information regarding the coexistence and quantitative relationship in foods of the two water soluble vitamins—the antineuritic and the antiscorbutic. Orange juice has been demonstrated to contain both in appreciable amounts. Similarly, Hess [17] had found that both are present in the tomato. Other foods which have been found to contain both in demonstrable quantities are banana,[18] cabbage,[19] potato [20] and turnip.[21] It is very probable that this list will be greately extended by further work.

The pathologic similarities of beriberi and scurvy have been pointed out by a number of workers.[22] Funk,[23] however, believed that foods which were specific for scurvy also protected against beriberi, although the "beriberi vitamin" was a prophylactic against beriberi only. At that time he did not appreciate that both vitamins might be present in one and the same food. That certain foods, for example milk, contain both vitamins, may also explain the fact that some of the symptoms of both diseases are sometimes present in one and the same individual, the disease type depending on the greater deficiency of the particular food accessory. Thus, similar heart signs and symptoms are described in both scurvy and beriberi. It is possible that the heart symptoms present in those babies who were suffering from scurvy were due, in part, to a lack of the antineuritic vitamin.

CONCLUSIONS

1. Orange juice contains a relatively large amount of the antineuritic vitamin.

2. The growth stimulating influence of orange juice appears to be due to the antineuritic vitamin contained therein.

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17. Hess, A. F., and Unger, L. J.: J. Biol. Chem. **38**:293, 1919; Proc. Soc. Exper. Biol. & Med. **36**:1, 1918.
18. Sugiura, K., and Benedict, S. R.: J. Biol. Chem. **36**:171, 1918. Lewis, H. B.: J. Biol. Chem. **11**:91, 1919.
19. McCollum, E. J., and Kennedy, C.: J. Biol. Chem. **24**:492, 1916. Cohen, B., and Mendel, L. B.: J. Biol. Chem. **35**:425, 1918.
20. McCollum, E. L., and Kennedy, C.: Loc. cit.
21. Osborne, T. B., and Mendel, L. B.: J. Biol. Chem. **39**:29, 1919.
22. Chicke, H., and Rhodes, M.: Lancet **2**:774 (Dec. 7) 1918. Darling, S. T.: J. A. M. A. **63**:290 (Oct. 10) 1914.
23. Funk, Casimir: Ergebn. d. Physiol. **13**:124, 1913.

3. Orange juice from which the antineuritic vitamin is removed by adsorption does not stimulate growth. This would seem to indicate that the antiscorbutic vitamin lacks growth stimulating properties.

4. The "pathological affinities" of beriberi and of scurvy may possibly be explained by the fact that the antineuritic content of the commonly used antiscorbutics has not been considered.[24]

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24. After this manuscript had been submitted for publication, we found the preliminary note of Mendel and Osborne (Proc. Soc. Exper. Biol. & Med. **17**:46 [Nov. 19] 1919) stating that they were studying the antineuritic content of fruits and had also observed that orange juice contained this growth stimulating material.

Reprinted from the American Journal of Diseases of Children
May, 1920, Vol. XIX, pp. 349-358

FIVE HUNDRED AND THIRTY-FIVE NORTH DEARBORN STREET
CHICAGO

Reprinted from THE JOURNAL OF BIOLOGICAL CHEMISTRY, Vol. XLIV, No. 2, November, 1920

A DEFICIENCY IN HEAT-TREATED MILKS.

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(From the Department of Nutrition, Child Welfare Research Station, University of Iowa, Iowa City.)

(Received for publication, August 9, 1920.)

From time to time during the past few years there have appeared in the literature reports of investigations dealing with the biological value of heat-treated milk. These are more or less contradictory, some authors contending that while certain chemical changes have resulted from the processes employed, they have not altered the biological value of the milk.[1] Indeed, in certain instances it has been pointed out that boiled milk of another species is better borne than raw milk. On the other hand, there are experiments which indicate that the nutritive value of raw milk is much greater than that of boiled milk. These varying results may be due (1) to the different methods employed in heating the milk; or (2) to the different lengths of time the experiments were run. Milk boiled quickly may have quite different values from that which has been brought slowly to the boiling temperature; and an experiment continued over many months may produce results which are not discernible in a short period investigation. Rickets is not a quickly developing syndrome, but the outcome of a greater or less deficiency over a considerable period.

Among those who contend that milk has been made less valuable by heating to high temperatures, there is little unanimity of opinion regarding the cause of the deterioration. Recent findings relative to the thermostability of the antiscorbutic vitamine may account for some of the apparent inconsistencies;[2] but, in those

[1] The literature has been reviewed by Lane-Claypon, J. E., Milk and its hygienic relations, London, New York, Bombay, and Calcutta, 1916, 225.

[2] Chick, H., Hume, M. E., and Skelton, R. F., *Biochem. J.*, 1918, xii, 131. Hess, A. F., and Fish, M., *Am. J. Dis. Child.*, 1914, viii, 385. Hess, A. F., *Am. J. Dis. Child.*, 1916, xii, 152.

cases where the investigations were carried out with rats, it would seem that the biologic impotency cannot be attributed altogether to the destruction of this vitamine, for rats in our laboratory which have been fed purified rations, containing no demonstrable amount of the antiscorbutic vitamine, throughout a complete life cycle have made what is considered normal growth; have reproduced; and reared their young. These, in turn, have repeated the performance of the parents.

Other substances which have been considered as possibly responsible for the lack of physiologic well being of animals fed heat-treated milk are the casein, and the antineuritic vitamine (water-soluble B). McCollum and Davis[3] fed rations in which the sole source of the water-soluble vitamine was superheated whey (15 pounds pressure for 1 hour) in certain cases; and in others the water-alcohol extract of wheat embryo similarly treated. There was no evidence that the vitamine was destroyed. The rats grew quite as well as control animals receiving similar rations containing the unheated materials. When, however, skim milk powder, heated for a considerable period in a double boiler, or for 1 hour in an autoclave at 15 pounds pressure, was used, growth was not comparable to that on the unheated powder. This heated milk powder also lost its potency as a supplementing material for rations consisting of polished rice, salts, and butter fat—rations which require both protein and the water-soluble food accessory to make them support growth. The addition of a growth minimum (10 per cent) of unheated casein to a ration consisting of superheated milk powder stimulated growth, which continued slowly throughout the experiment. The authors conclude that heating casein for 1 hour in an autoclave at 15 pounds pressure quite destroys its biologic value as a complete protein.

Hogan,[4] on the other hand, believes that high temperatures affect the vitamines rather than the proteins. He found that rations including superheated casein and egg white, as essential parts of the protein requirement, produced growth similar to that secured by rations containing the unheated proteins. In a second group of experiments, when corn mixtures, which fur-

[3] McCollum, E. V., and Davis, M., *J. Biol. Chem.*, 1915, xxiii, 247.
[4] Hogan, A. G., *J. Biol. Chem.*, 1917, xxx, 115.

nished the vitamines, were superheated before the addition of these proteins, growth was less marked than on similar rations which were unheated. Protein deterioration could not have been responsible for the lack of growth here. The vitamines appear to be at fault. There is, however, no experimental evidence to indicate which of the vitamines may have been affected.

Gibson and Concepción[5] fed fowls a diet of polished rice and milk, some being given raw milk (100 cc.), while others received an equal amount of rice and autoclaved milk. The results indicate that milk has little protective action against polyneuritis, for the birds receiving these additional milks developed polyneuritis in about the same time as those fed polished rice alone. The autoclaved milk, however, did not appear to promote the onset of the neuritic symptoms. When a considerably larger amount (200 cc.) of milk, either fresh or autoclaved, was fed, neither group developed neuritis and there was no evidence of degenerative changes in the peripheral nerves of these birds. From these results it would seem that the antineuritic vitamine had not been materially affected by the high temperatures (2 hours at 125°C.). Comparable results were also obtained with pigs and dogs.

Recently, some suspicion has been cast on the thermostability of the fat-soluble vitamine in certain fats. Osborne and Mendel[6] allowed steam to pass through butter oil for $2\frac{1}{2}$ hours. This, when used as the source of fat-soluble A in rations, gave every indication of being as efficient as the untreated butter oil. Steenbock and coworkers,[7] however, have reported that the fat-soluble vitamine is readily destroyed even below 100°C. It is probable that the apparent inconsistency in the results of these investigations lies in the fact that in one case the fat was heated in the presence of water (steam), whereas in the other no moisture was included. We have found no reports dealing with the effects of superheat on the fat-soluble complex as it exists in milk.

[5] Gibson, R. B., and Concepción, I., *Philippine J. Sc., Section B*, 1916, xi, 119.

[6] Osborne, T. B., and Mendel, L. B., *J. Biol. Chem.*, 1916, xxiv, 37.

[7] Steenbock, H., Boutwell, P. W., and Kent, H. E., *J. Biol. Chem.*, 1918, xxxv, 517.

In a recent study (1916) of the nutritive value of milk held at the boiling temperature for different periods, Daniels and Stuessy[8] observed that rats fed milk boiled 1, 10, and 45 minutes, respectively, grew slowly, failed to achieve the expected weight for normal animals, and never reproduced. Growth curves of rats receiving milk heated above 100°C. (114°C. for 45 minutes) were fairly comparable to those receiving milk held at the boiling temperature, nutrition disaster intervening only somewhat earlier. The addition of well washed coagulated egg yolk and casein to the diets of those animals receiving the milk held at the boiling temperature for 45 minutes, and of coagulated egg white to the superheated milk, caused growth to be resumed. The animals fed the egg yolk additions produced several litters of young which were successfully suckled. Although the authors offer in explanation of their results the possible destruction of some of the casein, which was supplemented by the added protein, they suggest that there might be other contributing factors, such as the vitamines and inorganic constituents which were responsible for the growth stimulation.

Since the first report, some of the above experiments have been repeated with the view of determining, if possible, what substance or substances are changed by the heating processes. In the earlier work, in order that all conditions during heating might be as nearly comparable as possible, equal quantities of milk (1 pint) were brought to the desired temperature in glass containers of the same size and form, which were completely surrounded by cold water. The period of boiling was counted from the time the milk reached the boiling temperature (98°F.), the time required to bring the milk to the boiling point (about 35 minutes) not being considered. In the new experiments, since the length of time the milk was held at the boiling temperature appeared to make but little difference in the growth of the animals, the milk was brought quickly to the boiling point in an open aluminum kettle, and the boiling continued for just 1 minute. At that time it was believed that milk brought quickly to the boiling point was in every way comparable to that heated by the former method. In these experiments special care was taken

[8] Daniels, A. L., and Stuessy, S., *Am. J. Dis. Child.*, 1916, xi, 45.

to select well nourished young rats from our stock group. Our rats of the first generation fed this quickly heated milk grew normally, and to all appearances were perfectly nourished animals (Chart 1). Growth in these rats was in such striking contrast to that of the earlier work that it seemed best to repeat the former experiments, heating the milk under the same conditions as before. Our results with this second group of rats fed the milk brought slowly to the boiling point were the same as those

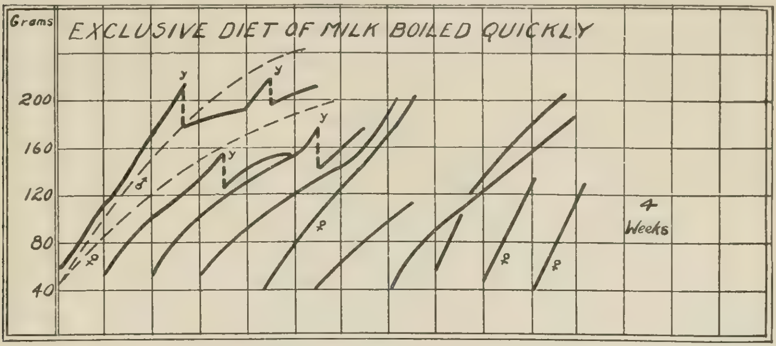

CHART 1. These animals were fed milk heated *quickly* to the boiling temperature and sustained for 1 minute.

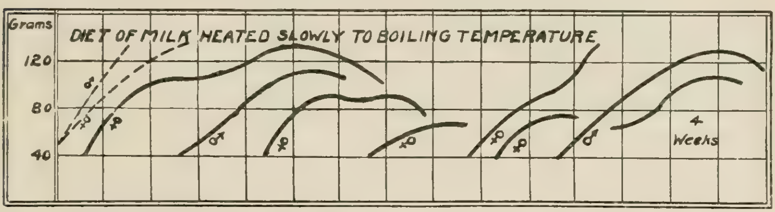

CHART 2. Rats fed milk heated slowly to the boiling temperature grew at about half the usual rate.

of the first experiments—the animals grew slowly, reached only about half the normal size, and failed to reproduce (Chart 2). A comparison of the growth curves of these milk-fed animals can lead to but one conclusion; namely, that milk brought quickly to the boiling temperature and held there for only a short period is little affected, while that which has been heated for a considerable period (35 minutes), even below the boiling temperature, is so changed that it fails to meet the nutritive requirements of rats.

The results with the slowly heated milk led us to investigate the effects of commercially canned milk and milk pasteurized by the "hold" system—a system used extensively in dairies and in institutions where numbers of babies are cared for. Previous experience in our laboratory with milk pasteurized by the "flash" system has indicated that it is little affected by the process. Rats grew as well on this as on milk raised quickly to the boiling temperature.

The pasteurized milk used in our experiments was prepared under the same conditions as that used for the babies in our children's hospital. The milk was placed in individual nursing bottles which were surrounded by cold water. The water was heated by steam to 65°C. in some cases, and in others to 82°C., the time required for heating varying from 30 to 45 minutes, depending upon the pressure on the particular day. The milk was then held at the desired temperature 40 minutes, after which it was cooled by running water and placed on ice.[9]

In our experiments with commercially canned milk, both the sweetened (condensed) and the unsweetened (evaporated) were used. In the latter case (evaporated milk) three brands, designated as Brands A, B, and C, were tested. In one case only were we able to get definite information regarding the methods of preparation. We infer that the methods employed in the other two cases were similar. The process consists in holding the milk at the boiling temperature for approximately 10 minutes. It is then evaporated *in vacuo* at a temperature of 130–140° F. until the ratio is approximately two to one. After cooling, it is canned, sealed, and sterilized at 240° F. for about 20 minutes. These milks diluted with equal quantities of distilled water, to which a few specks of iron citrate were added, were fed *ad libitum*, especial care being taken to see that an abundance of milk was always provided.

In the production of the condensed milk tested according to the statement of the manufacturer, after adding the sugar the

[9] We appreciate that the temperature of pasteurization was somewhat higher than that used in the commercial process, and therefore no conclusions regarding the biologic value of the commercially pasteurized milk can be drawn. Experiments with milk commercially pasteurized are now in progress.

milk is first heated to approximately 290° F. This is then condensed to the desired consistency in vacuum pans, the temperature during this part of the operation averaging 150° F., but as the milk condenses the temperature gradually drops until it reaches about 120° at the completion of the process. This milk was fed undiluted, distilled water being provided in other containers.

The growth curves of the rats fed the pasteurized milk (Chart 3) are very similar to those of animals which received the milk heated slowly to the boiling temperature. As in the latter case,

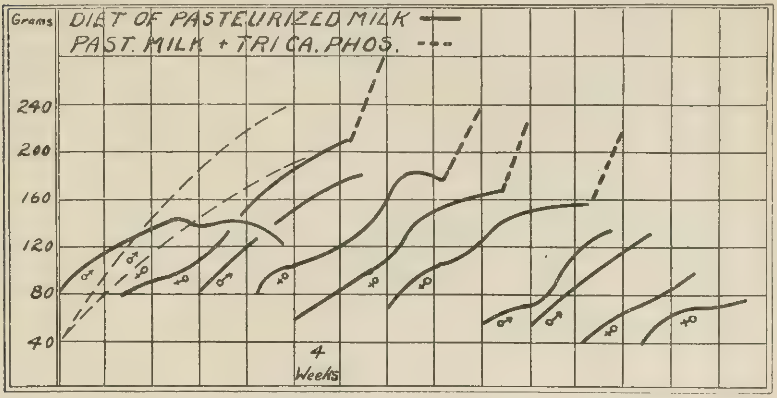

CHART 3. Growth curves of rats fed milk pasteurized by the "hold" process in the apparatus used for pasteurizing the hospital infants' milk feedings. During Period 2 (represented by the broken line) the addition of tricalcium phosphate incorporated in a starch paste stimulated growth

the rats grew at about half the usual rate and never attained the normal size for adult animals.

With the unsweetened (evaporated) milk the results were even more surprising (Chart 4). On Brand A the animals made almost no growth gains and died after a few weeks. On Brands B and C slightly better results were obtained. The animals gained slowly and lived for somewhat longer periods, but all ultimately died in a miserable condition—emaciated, with roughened coats, but with no signs of xerophthalmia. The somewhat better results with Brands B and C may possibly be explained by the fact that the animals on these were about 2 weeks older when the experiment was begun.

The animals fed the sweetened (condensed) milk[10] made decidedly better growth than any of our rats fed the other forms of long heat-treated milk; in fact their curves of growth are fairly comparable to those of normal animals (Chart 5, Group 2). Although the temperatures used in the process of condensing,

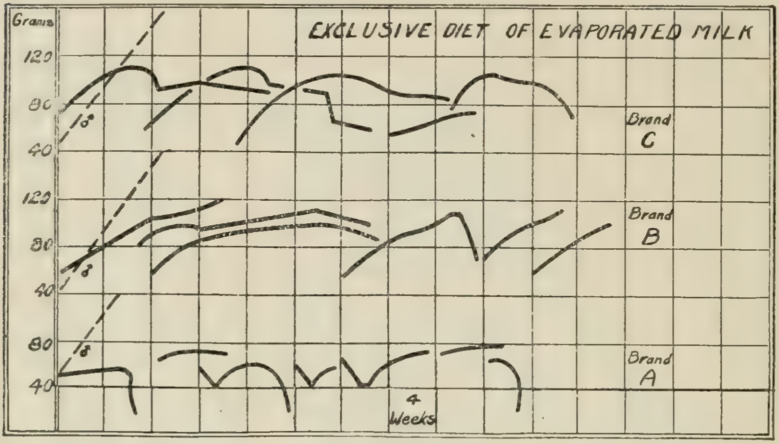

Chart 4. Animals fed evaporated milk (unsweetened) made scarcely no growth and died after a few weeks.

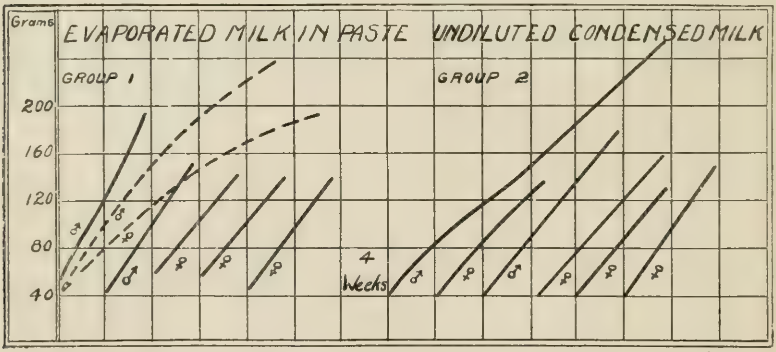

Chart 5. Group 1 indicates the rate of growth of animals fed evaporated milk made into a starch paste.

Group 2 are growth curves of animals fed undiluted condensed (sweetened) milk.

[10] We are indebted to Miss Emma Francis, Battle Creek, Michigan, for assistance in these experiments.

after the initial step, were not so very different from those employed in our pasteurization processes, the chemical changes produced, seemingly, had not taken place. In view of our other findings these results were at first confusing. The explanation, however, was forthcoming later in the investigation.

In studying what changes had taken place in the unsweetened (evaporated) and our long heat-treated milks, our attention was first directed toward the possible destruction of the two vitamines, fat-soluble A and water-soluble B. The addition of liberal amounts (25 cc. per 200 cc. of milk) of the water-alcohol extract of wheat embryo to the milk raised slowly to the boiling temperature produced no perceptible change in the growth curves of these animals. Nor was there any evidence that the antineuritic vitamine was affected in the milk heated to the higher temperatures (evaporated milk). Those animals fed purified rations[11] in which the antineuritic material was supplied by fresh milk in one case and diluted evaporated milk in another, gave no indication that the antineuritic vitamine was destroyed by the condensing process (Chart 6). During the early part of the investigation too little milk (less than 200 cc. per 100 gm. of ration) was added to produce normal growth. The growth curves of the animals receiving the evaporated milk additions, however, were consistently better than those of animals receiving the fresh milk mixture. These better results seem to point to a higher antineuritic content of the food mixture containing the evaporated milk. In preparing the foods especial care was taken to dilute the evaporated milk with equal quantities of distilled water. A comparison of the protein ($N \times 6.25$) content of this diluted milk (3.5 per cent) and the fresh (3.3 per cent) milk suggested that the evaporated milk, as fed, might contain slightly more of the vitamine. We appreciate, however, that the amount of protein

[11] The purified rations consisted of:

Casein	13.5 gm.
Corn-starch	77.0 "
Suitable salt mixtures	6.0 "
Milk, evaporated	28.0 cc.
" fresh	56.0 "

The precipitated casein was washed 24 hours in running water, dissolved in 0.2 per cent sodium hydroxide solution, reprecipitated with diluted acetic acid, and again washed 24 hours in running water.

a milk contains can be, at best, only a very rough estimate of its antineuritic value. Nevertheless, if the antineuritic vitamine had been considerably destroyed by the prolonged heat treatment employed in the evaporation processes, it would have been evidenced, we believe, by a slower growth rate of the animals fed the evaporated milk ration.

We have been unable also to obtain data indicating that the fat-soluble vitamine is appreciably affected, if at all, by the heat treatment of milk. The addition of butter oil (2 gm. per 100 cc. of diluted milk) was without effect in stimulating growth

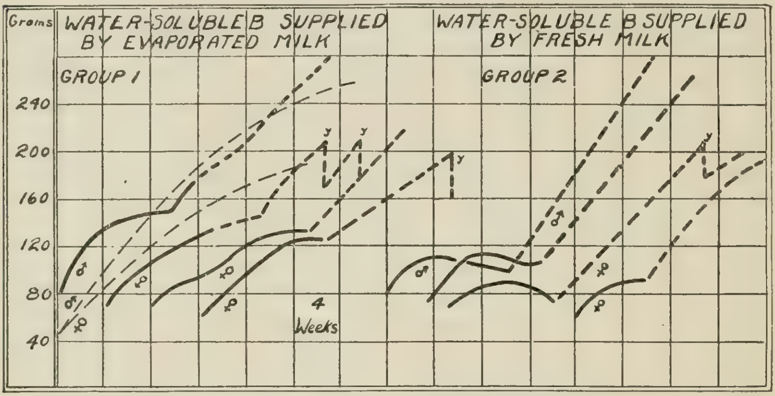

CHART 6. Animals fed purified rations in which evaporated milk (100 cc. during Period 2), Group 1, and fresh milk (200 cc. during Period 2), Group 2, respectively, supplied the only water-soluble vitamine made comparable growth gains.

in the stunted animals fed the superheated (evaporated) milk. A comparison of the growth curves of animals fed a purified ration in which the fat-soluble vitamine was supplied very largely by 2 per cent of milk fat from evaporated milk (28 cc. per 100 gm. of ration), and fresh milk (56 cc. per 100 gm. of ration), respectively, gave no evidence of the destruction of this vitamine (Chart 7). During the period of investigation both groups have made normal growth gains, and in neither has there been any indication of xerophthalmia. The purified ration for these particular groups was prepared from casein obtained from centrifuged milk. This was not ether-extracted, nor was the wheat embryo used as

the source of the water-soluble vitamine extracted previous to the alcoholic treatment. It is obvious, therefore, that somewhat more than 2 per cent of butter fat was being fed. But since it has been shown that 5 per cent is essential for normal growth,[12] it was believed that if a considerable destruction of the butter fat had taken place in the superheated milk it would be made apparent by the comparative study.

The addition of both vitamines—the water-soluble and the fat-soluble—produced no growth stimulation in the stunted

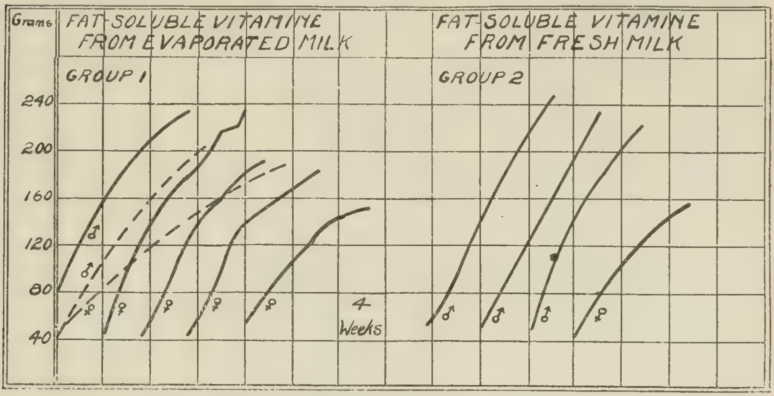

CHART 7. Growth curves of animals fed purified rations in which the fat-soluble vitamine was supplied by 2 per cent of fat from evaporated milk (Group 1), and fresh milk (Group 2). In these rations the casein and wheat embryo which furnished the extract containing the water-soluble vitamine were not ether-extracted.

animals fed the evaporated milk. If either of these vitamines was affected by the methods of heating, it was not indicated by our investigation.

The insoluble precipitate on the sides and in the bottom of some of the cans of evaporated milk used in the investigation suggested that the inorganic constituents, in part at least, might be responsible for our growth failures. It is well known that boiling brings about changed relations in the inorganic complexes of the milk, resulting in an increase of the insoluble calcium and

[12] McCollum, E. V., and Davis, M., *J. Biol. Chem.*, 1915, xx, 641.

magnesium salts, especially the calcium phosphates,[13] at the expense of the soluble forms. But all evidence in stock feeding, at least, points to the conclusion that these di- and tri-basic salts are available. Bone ash and precipitated calcium phosphate are usual additions to certain types of farm rations.[14] The additions of mono-basic and di-basic calcium phosphate, respectively, to our milk foods were without significant influence. The mono-basic salt was apparently distasteful, for when this was added very little of the milk was eaten. With the di-basic phosphate somewhat better results were obtained, but growth was still considerably below normal. When calcium lactate was

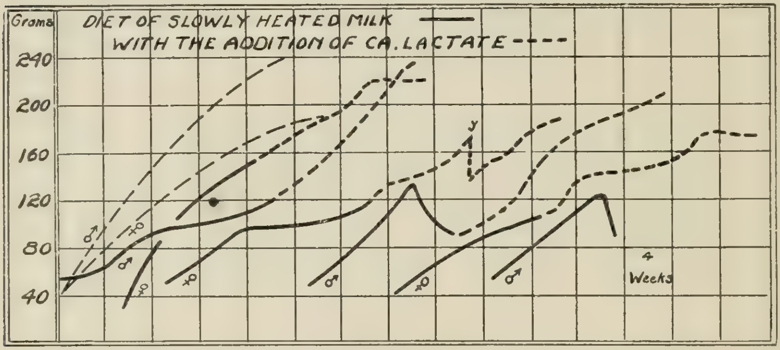

CHART 8. The addition of calcium lactate to milk brought slowly (35 minutes) to the boiling point, stimulated growth (Period 2). The rate of growth, however, is considerably less than the optimum.

added to the milk brought slowly to the boiling point, growth was stimulated in animals previously stunted on this milk alone (Chart 8). Furthermore, young animals fed both the long heat-treated milk, and the superheated milk (evaporated) to which calcium lactate (approximately 0.77 gm. per 100 cc. of milk) was added from the beginning, made fairly satisfactory growth gains; and in a number of cases young were born (Charts 9 and 10). Very occasionally we succeeded in raising a few of a second generation. However, the number of young which we failed to

[13] *Bull. Hyg. Lab., U. S. P. H. No. 56*, 1909, 2nd edition, 646.

[14] Henry, W. A., and Morrison, F. B., Feeds and feeding, Madison, 16th edition, 1916, 66.

raise, and the fact that our first generation was somewhat below the accepted standard for well nourished rats, suggested that calcium lactate only in part made up the deficiency produced by the heat treatment of milk. The additions of considerably larger amounts of calcium lactate produced no better results.

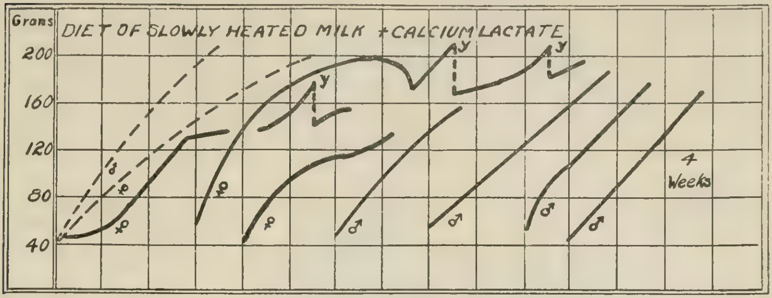

CHART 9. These animals were fed, from the beginning of the experimental period, milk brought slowly to the boiling temperature, to which calcium lactate was added.

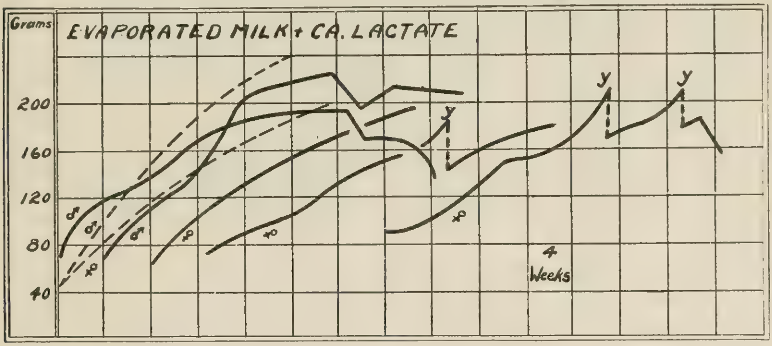

CHART 10. The addition of calcium lactate to evaporated milk produced much better growth than evaporated milk alone. In some cases young were born; a few lived through the suckling period.

It seemed probable that our lack of success with the dicalcium phosphate might have been due to the fact that enough of the salt could not be dissolved in the milk to meet the needs of the experimental animals, therefore the more soluble calcium glycerophosphate was tested. The substitution of this for the calcium

lactate stimulated growth (Chart 11, Group 1). By incorporating the calcium glycerophosphate in a paste of diluted evaporated milk and corn-starch, our results were even more successful. The growth curves of these animals (Chart 11, Group 2) were quite similar to those of animals fed milk boiled 1 minute. With our calcium glycerophosphate additions young rats have grown to maturity and reproduced at a comparatively early age. This is the first time in our many experiments with long heat-treated, or superheated milk that we have been able to secure results at all comparable with those obtained on raw milk (Chart 12) or milk brought quickly to the boiling point (Chart 1).

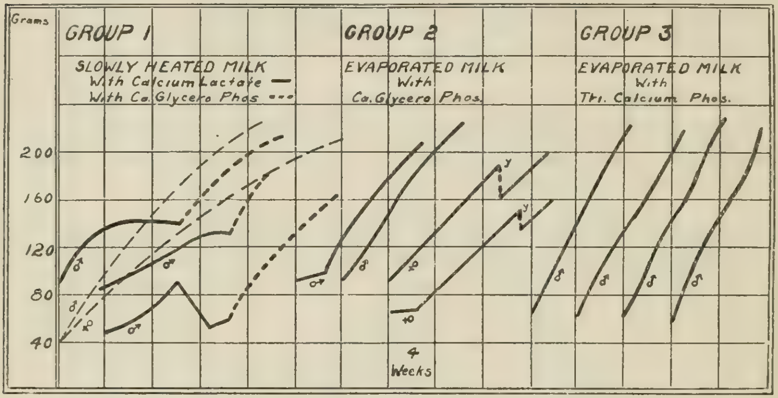

CHART 11. The substitution of calcium glycerophosphate for calcium lactate in the diet of rats fed slowly heated milk stimulated growth (Group 1).

Calcium glycerophosphate added to evaporated milk produced normal growth curves. Young were born at a comparatively early age (Group 2).

Evaporated milk supplemented with tricalcium phosphate in a starch paste produced equally good growth (Group 3).

As has been stated, all evidence in the literature is to the effect that tricalcium phosphate when fed to stock is available. Do rats differ from farm animals in being unable to utilize this tri-basic salt? In order to determine this we fed evaporated milk (Brand A), and supplemented this with the insoluble salt incorporated in a starch paste. The growth of these animals (Chart 11, Group 3) is superior to that of any of our milk-fed rats,

and leaves no doubt concerning the availability of this tri-basic salt.

Why then did our animals fail to grow on the long heat-treated and evaporated milk? Two possibilities suggest themselves. In the process of condensing, a certain amount of the calcium phosphate is precipitated and may be discarded as waste, although in the published analyses[15] there is no evidence that such has been the case. It is also possible that some of the insoluble material settled to the bottom of the feeding containers and was not taken by the animals. Rats fed the diluted evaporated milk (Brand A) thickened with corn-starch made practically normal

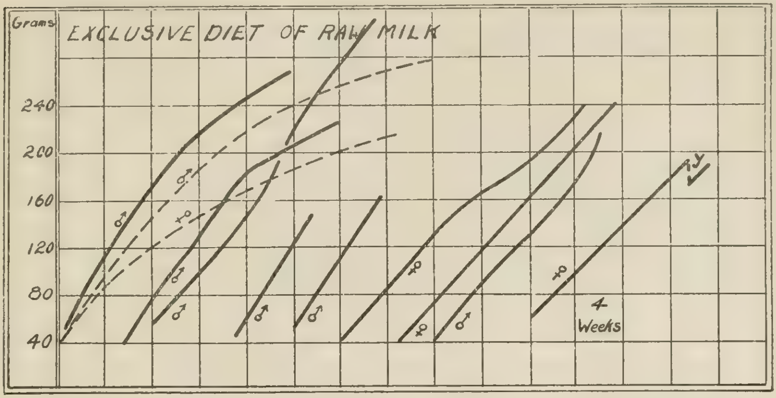

CHART 12. Growth curves of first generation rats fed raw milk.

growth gains during the 8 weeks of the investigation (Chart 5, Group 1). A comparison of these curves with those of our animals on the unthickened evaporated milk suggests that the growth failures of our animals on the evaporated milk were due to the fact that the insoluble calcium phosphate in the diluted milk settled out and was not eaten.

Can the nutritive failures of our animals fed the long treated milk, that is the milk brought slowly to the boiling point, and the pasteurized milk, be similarly accounted for? In these we have never been conscious of any considerable precipitate,

[15] Sherman, H. C., Chemistry of food and nutrition, New York, 2nd edition, 1918, 424.

although slight precipitates were frequently observed on the sides and bottom of the containers in which the milks were heated. In order to test this point, animals previously stunted as the results of pasteurized milk feeding were given in addition the tricalcium phosphate starch paste. As in the case of the evaporated milk-fed rats growth was immediately stimulated (Chart 3), suggesting that in the "hold" process of pasteurization the insolubility of the calcium salts was responsible for the growth failures. When the bottles in which the milk was pasteurized were carefully washed out with distilled water and the washings incorporated in a starch paste, the animals made better gains

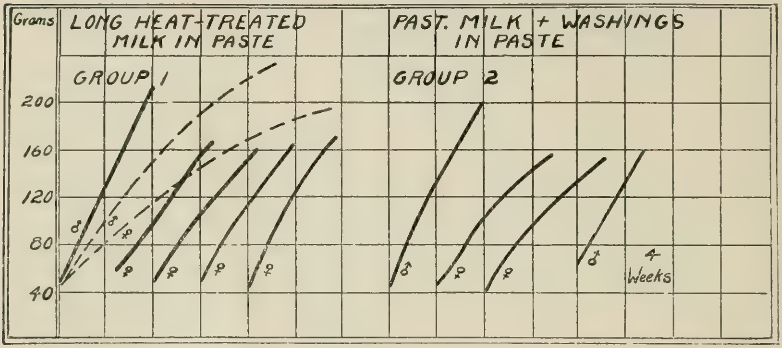

CHART 13. Long heat-treated milk made into a paste also produced growth superior to that of the long heat-treated milk alone (Group 1).

The washings from the containers in which the milk was pasteurized, when added to the pasteurized milk in the form of a paste, produced better growth than the pasteurized milk alone (Group 2).

than on the pasteurized milk alone (Chart 13, Group 2). Similarly, our animals fed long heat-treated milk incorporated into a paste made normal growth gains (Chart 13, Group 1). In both these cases the results can be explained only by the fact that the calcium phosphates were held in suspension by the colloidal solution and therefore were made available.

The growth of the animals fed the thickened heat-treated milk suggested an explanation for our results with the condensed milk. This milk, it will be recalled, is of a thick, semisolid consistency, and in our experiments it happened that this was fed

undiluted. Any insoluble calcium salts formed during the condensing process, therefore, were held in suspension. The thick mixture made it possible for the animals to get all the calcium phosphates present.

The explanation for the results obtained in the previous investigation[8] following the addition of egg yolk and casein to the long heat-treated milk, is now apparent. Both of these materials furnished appreciable amounts of calcium and phosphorus—substances which have been shown to be deficient in long heat-treated milk.

The results of all our experiments on the long heat-treated milks point to the same conclusion; namely, that, in the process of heating, the calcium salts are rendered more or less insoluble, depending upon the length of time the milk is heated. In this insoluble form they may be lost, owing to the fact that some of the precipitated material adheres to the container, as in the case of long pasteurized or slowly heated milk, while some, for example in evaporated milk, separates out on standing. When especial care was taken to include the insoluble material by colloidal suspension, results comparable to those on raw and quickly boiled milk were obtained. We have secured no data indicating that either the fat-soluble or the water-soluble vitamine in milk is affected by heat treatment. Nor is the casein apparently affected. Rats fed superheated milk supplemented with calcium phosphate properly incorporated made normal growth gains. The inferior growth of rats on the long heat-treated and super heated milk appears to be due wholly to the readjustments of the inorganic complexes.

The application of these findings to infant nutrition is now under investigation.

FIRST SERIES NO. 42 FEBRUARY 1, 1921

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 6

CHILD LEGISLATION IN IOWA

BY

Frank E. Horack

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rates of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918

UNIVERSITY OF IOWA STUDIES IN CHILD WELFARE

PROFESSOR BIRD T. BALDWIN, PH. D., EDITOR

FROM THE IOWA CHILD WELFARE RESEARCH STATION

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OUTLINE

EDITOR'S FOREWORD

Science has for years been extending the period of the infancy of man. The present tendency of legislation is for the federal government and the several states to extend their care and protection of children in order to give them time to grow, to be educated, and to become trained for good citizenship. Professor Horack has shown in his analysis of state legislation relating to the child in Iowa that this great commonwealth has conceived the child's right to be protected in the home and through private and institutional care, in health, morals, education, and industry, in addition to safeguarding his legal and property rights.

In general the laws of this state bearing on child welfare are good, with special application to all ages and all classes and with an increased tendency toward constructive legislation. This is particularly true of the basic compulsory education law of 1902; the juvenile court act of 1904; the child labor legislation of 1906 and 1915; the mothers' pension provisions of 1913; the contributory dependency act of 1909; the Perkins law of 1915; and the act establishing the Iowa Child Welfare Research Station in 1917.

On the other hand, there are also many inconsistencies and considerable lack of uniformity throughout the statutes in regard to age classifications and provisions for the proper administration of particular laws on vital statistics. There is a failure to distinguish between delinquent, dependent, neglected, and destitute children; to guard against the possibility of children's being confined in county homes; and to provide for close supervision of the placing out of children. Equally inadequate are the legal provisions for determining who are feeble-minded in schools or in homes, and for training defectives or delinquents in publicly supported schools or colonies.

Each of the problems outlined in this study will offer a wide field for further work and investigation. There is urgent need for a detailed study of the present administration and interpretation of the laws of the state.

In this analysis of the legal status of the child in Iowa, Professor Horack has made a distinct contribution to the work and service of the Research Station. The Iowa Child Welfare Research Station is ready to serve not only as a research station for the scientific investigation of the conservation and development of Iowa's children, but also as a coördinating center and a service station in the field of child welfare without assuming the work or duties of other institutions, organizations, or committees.

BIRD T. BALDWIN

Office of the Director,
Iowa Child Welfare Research Station,
University of Iowa, Iowa City.
September 27, 1920.

CHILD LEGISLATION IN IOWA

I. INTRODUCTION

Society has come to recognize the truth of the saying, "as the twig is bent the tree is inclined." This belief is of first importance in any discussion of the subject of how good citizenship can be promoted. Good citizenship requires adequate care and protection of childhood.

The laws of our states, as also of the federal government, have more and more tended to insure by statute adequate care and protection to children, in order that they may become good citizens and be entrusted with the duties and responsibilities of citizenship. In the attainment of this goal there has been a marked tendency to prolong the period of childhood in the life of the individual—a tendency that will no doubt be strengthened by the new influence of women in the political affairs of the state.

The laws of Iowa do not always apply uniformly to all children up to the age of their majority. In the first place there are numerous classifications as to age, particularly in respect to industry, crime, and dependency. Special provisions of law apply to (1) the unborn as well as the born, (2) the legitimate and the illegitimate, (3) male and female, (4) the normal and the abnormal, (5) the healthy and the diseased, (6) the poor and the propertied, (7) the employed and the unemployed, (8) those of school age and those not of school age, (9) the delinquent and the law-abiding, (10) the imprisoned and the paroled, (11) the single and the married and (12) the orphaned, neglected, and abandoned, as well as those under adequate parental care.

Thus it can readily be seen that legislation relating to the child in Iowa covers a very wide range of topics. These laws are scattered throughout the entire code, but the compilation of the law by the recent code commission, together with an excellent index, has greatly lightened the task of the writer. All of the references are to the compiled code of 1919, but inasmuch as the compiled code has not been officially adopted, all quotations of law have been veri-

fied from the original sources. The original sources are indicated in brackets at the end of each section of the compiled code of 1919.

The material presented in this study is in no way intended as a children's code, but rather as a narrative account of the various phases of child legislation now on the statute books. The author has not attempted to suggest what the law of the state in this field ought to be. Having been shown what the law is, the experts in the field of child welfare can readily suggest the omissions or necessary amendments. Neither has the writer attempted to deal with the administration or the interpretation of the law, as this would make a special study in itself and is beyond the scope of this paper.

II. CITIZENSHIP AND DOMICILE

The citizenship of children in the United States is determined by the provisions of the fourteenth amendment to the constitution of the United States which states that: "All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the State wherein they reside." Congress however, has full power to prescribe who may be naturalized, and has limited citizenship by naturalization to white persons or persons of African nativity or of African descent. No state can withhold citizenship from those born within its own jurisdiction or within that of the United States. The Supreme Court of the United States has held that children born in the jurisdiction of the United States are citizens even though their parents (being Chinese or Japanese) are denied citizenship by naturalization under the laws of Congress. Thus it is apparent that the children of Iowa gain their citizenship in the United States and in the State under the provisions of the Federal constitution and the laws of Congress.

Each state, however, may make reasonable provisions as to how, and under what conditions, persons may qualify for the exercise of rights and the enjoyment of privileges within the state according to the state constitution and laws. Thus the Iowa constitution provides that "Every male citizen of the United States, of the age of twenty-one years, who shall have been a resident of this State six months next preceding the election, and of the County in which he claims his vote sixty days, shall be entitled to vote at all elections which are now or hereafter may be authorized by law."

Legal Settlement. The legislature, however, has determined what constitutes a settlement in this state, and this is often of prime importance in determining the right of a child to poor relief. Thus the code of 1897 provides that "any person having attained majority, and residing in this state one year without being warned (to depart) . . . . gains a settlement in the county of his residence." Thus it would appear that a person coming into Iowa from another state could acquire state citizenship after six months' residence in the state and sixty days' residence in the county which would entitle him to vote; yet if he became a public charge before the expiration of one year he could not claim a settlement in the state under the provisions of the code just cited. The code further provides that "Legitimate minor children follow and have the settlement of their father, if he has one, but if he has none, then that of the mother; illegitimate minor children follow and have the settlement of their mother, or, if she has none, then that of their putative father."

A minor whose parent has no settlement in this state, by residing one year in any county gains a settlement in such county. But a minor bound out as an apprentice immediately acquires the settlement of his master.[1] Thus it appears that one may acquire state citizenship before acquiring a settlement, or one may acquire a settlement without having acquired state citizenship. But the important question in nearly all cases of orphaned, abandoned, neglected, or pauper children is: Have they acquired a domicile or settlement within the state?

III. REGISTRATION OF BIRTHS

For a complete and proper registration of births for legal, sanitary, and statistical purposes the code constitutes the clerk of the district court as county registrar, whose duty it is to inform all physicians, midwives, and the people of the county in general that all births must be reported to him within ten days, and that in case the child is not named at the time the report is made a supplementary report must be made giving the name of the child when named. Even more explicit are the provisions of the law putting upon the person or persons in charge of a maternity hospital the responsibility of keeping "a true, accurate and complete register of all patients and of all births and deaths occurring upon said

premises, giving date of entry of each patient, date of birth and name of each child born on said premises, and the age of all children dying thereon.''[2] Special blanks are furnished by the state board of health for this purpose. Moreover the state has protected the mother and the child born in such hospitals from the curious eyes of the scandal monger, by providing that the birth records required in such cases ''shall be accessible to the members of the state board of health, members of the board of control of state institutions, the attorney-general, and any county attorney in the state, and to no other person except on order of a court of record.''[3]

IV. WHO ARE CHILDREN IN IOWA

Boys and girls do not pass from childhood to their majority at the same age in Iowa. The code declares that ''the period of minority extends in males to the age of twenty-one years, and in females to that of eighteen years; but all minors attain their majority by marriage.''[4] Inasmuch as the law of Iowa recognizes as valid a marriage between a male of sixteen and a female of fourteen years of age, children marrying before reaching their majority thus become independent of parental control so far as their personal and property rights are concerned, but neither of them would be entitled to vote until they had reached the age of twenty-one.

Many laws apply only to children of certain ages or in certain circumstances, but except as just noted all normal persons not under conviction of crime are presumed to be under the control of parent or guardian or of some institution having the authority of parent or guardian until they reach their legal majority. The manifest purpose of the law is to guide the child in his adolescent period not only for his own benefit but for the benefit of society.

V. THE RIGHT TO BE PROTECTED AND CARED FOR

A. Domestic or Private Care of Children

Under the above title the writer has included all of those provisions of the law intended to insure to the child a home and adequate care and maintenance. This naturally includes dependent and defective children, and inasmuch as dependent and delinquent children are handled in the same chapters of the code, and in many

instances are evidently treated exactly alike, it seemed expedient to consider delinquent chilren and juvenile offenders also under this heading. It is no doubt expected that adequate care and training will ultimately make good citizens out of juvenile delinquents.

1. *By Parents or Guardian.* The presumption of the law is that every child is entitled to proper care and support either from parents, guardian, county, or state,or, if under apprenticeship, from his master. Numerous provisions have thus been made to insure the child adequate care and support from one or more of these agencies. The law presumes that parents will support and care for their own children, and it is only in those cases of parental neglect that the law attempts to define parental duty toward their offspring.

The terms dependent children and neglected children are defined as meaning "any child who for any reason is destitute or homeless or abandoned; or dependent upon the public for support; or who has not the proper parental care or guardianship; or who habitually begs or receives alms; or who is found living in any house of ill fame, or with any vicious or disreputable person; or whose home, by reason of neglect, cruelty or depravity on the part of its parents or guardian or other person in whose care it may be, is an unfit place for such child; and any child under the age of ten years, who is found begging, or giving any public entertainment upon the street for pecuniary gain for self or another; or who accompanies or is used in aid of any person so doing; or who, by reason of other vicious, base or corrupting surroundings, is, in the opinion of the court, within the spirit of this act."[5]

The statute having separately defined dependent and delinquent children makes little further distinction between them either in the procedure by which they may be committed to an institution, or the care given them. Provision, however, is made for financial aid to widowed mothers, who are poor and unable properly to care for their children but are otherwise proper guardians. In such cases the court may enter an order stating the facts and fixing an amount of money, not exceeding $2.00 per week per child, necessary to enable the mother properly to care for her children. But no such payments shall be made for any child over sixteen years of age.

Whenever a child has been found to be dependent, the court may summon the parent or parents of such child to inquire into their ability to support the child or contribute to its support. In case they are found capable of doing so, the court may enter an order or decree "as shall be according to equity in the premises, and may enforce the same by execution or in any way in which a court of equity may enforce its orders or decrees."[6] Moreover any person found guilty of contributing to the dependency of a child may be put under bond to insure the care and maintenance of the child or be himself placed under guardianship; and in case he is physically and mentally able to work and refuses to do so, after suitable employment has been provided for him, and approved by the court, he may be held to be in contempt of court. In addition it is made the duty of the board of supervisors and the cities of such counties to give preference to such persons in the matter of work. The obligation of the parent to support his offspring is expressed in the following words: "This statute . . . . shall be liberally construed as punishing the party affected as for contempt in case he does not do his parental duty and support his children as the law contemplates that he should do, after he has been ordered by the court to do so and efforts have been made to aid him in so doing."[7]

The law having imposed obedience upon the child up to the time of his majority, it has likewise insisted that he be entitled to protection and support. The law, however, does recognize the ability of a child of over sixteen years of age to support himself, though the parent or guardian may claim his earnings in return for the care and support given him. Thus the workmen's compensation act, enumerating those who shall be conclusively presumed to be wholly dependent upon a deceased employee, lists, among others, a child under sixteen years of age and a parent of a minor entitled to the earnings of the employee at the time the injury occurred.[8]

Children born out of wedlock are not deprived of the protection of the law in the matter of support. A number of sections of the code provide the method of procedure against the alleged father of a child born out of wedlock and make provision for the attachment and seizure of enough of his property to insure the support and maintenance of such a child.[9] Proceedings may be begun

against the mother independently of, or jointly with the alleged father for such support.[10]

The man who fails to support his dependents finds little consolation in the law. The court may "levy upon any of his property, including wages, for the benefit of the family," and he is not given the benefit of exemption provided by statute, except such as are provided for an unmarried person.[11]

2. *By Adoption.* The whole law of adoption seems to have as its chief purpose the securing of adequate care and protection to children who might otherwise be neglected. The code declares that any one competent to make a will, that is, of sound mind, "is authorized to adopt as his own the minor child of another, conferring thereby upon it all the rights, privileges and responsibilities which would pertain to it, if born in lawful wedlock to the person adopting."[12] Provisions for the consent of the parents or whoever has the lawful custody of the child; and the procedure by which the adoption is made legal is also made in considerable detail.[13] Especially explicit is the law providing that children born in maternity hospitals shall not be adopted or disposed of "without the articles of adoption being filed as required by law."[14]

Whenever a child has been declared abandoned as provided by law, then the clerk of the district court may sign papers for its adoption, or it may be turned over to some home-finding association or state institution "with power to adopt such child out and to execute papers of adoption."[15] Home-finding associations of other states must, however, furnish the state board of control with such guarantee as it may require that no child will be brought into the state of Iowa by such organization or its agents, if the child has contagious or incurable disease, or has any deformity, or is feeble-minded, or of vicious character. Such an association must also agree that it will "promptly receive and remove from the state any child brought into the state of Iowa by its agents, which shall become a public charge within the period of five years after being brought into this state."[16]

3. *Children Placed Under Contract.* Provision is also made for the adoption of children in the Iowa Soldiers' Orphans' Home[17] or in the Juvenile Home.[18] Children received in either the Soldiers' Orphans' Home or the Juvenile Home are declared to be wards of the state and may be placed "with any person or family of

good standing and character'' by contracts which shall provide ''for the custody, care, education, maintenance and earnings of the child,'' for the time fixed in the contract, which however can not extend beyond the time of his majority.[19] If, however, a child, whether adopted or placed under articles of agreement for a term of years, is not given the care, education, and maintenance as required, the board of control is given authority to recover possession of such child and make such other disposition of it as may be deemed best for the interests of the child.[20] In fact, in cases of maltreatment or neglect of duty by an adopted parent, the district court may take the child and intrust it to another at the expense of the adopted parent.[21]

The final section of the chapter on the Compulsory Support of Neglected Children reads: ''This chapter shall be liberally construed in favor of the state for the purpose of the protection of the child from neglect, or omission of parental duty toward the child by its parents, or other persons standing *in loco parentis,* and further to protect the child from the effects of the improper conduct or acts of any person which may cause, encourage or contribute to the dependency and neglect of such child, although such person is in no way related to such child.''[22]

B. INSTITUTIONAL CARE OF CHILDREN

The institutional care of dependent, defective, and delinquent children is provided for in considerable detail. These institutions, with the exception of the school for the deaf and the school for the blind, are under the board of control. The two exceptions are under the board of education.

1. *Dependent Children. The Soldiers' Orphans' Home.* The Iowa Soldiers' Orphans' Home was established shortly after the war of the rebellion for the care of the ''destitute children of soldiers, sailors and marines, residents of this state, orphans of soldiers under fifteen years of age, who are destitute or unable to care for themselves.'' By subsequent legislation ''other destitute children of like age who have a legal settlement in the state'' may be admitted to the home, but only in case there are not enough applicants in the former class to fill the home.[23] Children in the Soldiers' Orphans' Home are declared to be wards of the state and subject to the rules and regulations of the institution and they may be ex-

pelled for disobedience or refusal to submit to proper discipline. The law moreover provides that they shall be discharged from the home "upon arriving at the age of sixteen years, or sooner if possessed of sufficient means to provide for themselves."[24]

Each county is made "liable for sums paid by the home in support of all its children, other than the children of soldiers."[25]

The Juvenile Home. The board of control of state institutions was commissioned by an act of the Thirty-Eighth General Assembly to "establish a fit and proper Juvenile Home for the reception and care and education of dependent, neglected, delinquent or destitute children residents of Iowa."[26]

In accordance with the authority granted them, the board of control has purchased the grounds and buildings of Leander Clark College at Toledo, Iowa, and converted the same into the Juvenile Home.

Although the law lists dependent, neglected, delinquent, or destitute children as admissible to the home, it is, however, clear that the inmates are of two classes, dependents and delinquents. The law specifically declares that only mentally and physically normal children will be admitted. The children admitted must be under fifteen years of age and may be sent to the home by adjudication of the district and superior courts of the state or without adjudication upon application approved by the board of supervisors of the county of legal settlement or a judge of a court of record having jurisdiction in said county.[27]

The County Orphans' Fund. It is evident from a reading of the code that not all destitute orphans need be committed to institutional care. The board of supervisors is authorized to "levy a tax, not exceeding one-half mill on the dollar in any one year, on all taxable property in its county, at the same time other taxes are levied . . . . to aid in and for the maintenance and education of destitute orphans." The fund thus raised is to be "expended in such sums and manner as the exigencies of each case may demand. If there are such children who are without guardian, or, having one, are neglected, they shall be cared for through some suitable person to be appointed by the board."[28]

2. *Defective Children: The Deaf and the Blind.* There are four state institutions in Iowa devoted to the care of defective children, namely, the School for the Deaf, the School for the Blind, the

Institution for Feeble-minded and the State Colony for Epileptics. The first two institutions are rated as educational institutions. They are under the jurisdiction of the State Board of Education; and the chief object of each institution is to overcome, as far as possible, by special education and training the defect of sight or hearing.

The other two institutions, while providing such education as the inmates are capable of receiving, are established primarily for the protection of society by segregating those who can not be held responsible for their own acts.

The Feeble-minded. The law declares that the purpose of the feeble-minded institution is to train, instruct, care for, and support feeble-minded children. The statute declares moreover that the term feeble-minded "shall be so construed as to include idiotic children," and provision is made for a custodial department for the care of those who cannot be benefited by educational training.[29]

"Every child and youth residing within the state, between the ages of five and twenty-one years, who by reason of deficient intellect is rendered unable to acquire an education in the common schools, is entitled to receive the physical and mental training and care of this institution at the expense of the state." The county superintendent is required to report annually on the first day of October to the superintendent of the institution "the name, age and post-office address of every person in his county of such age who, by reason of feeble mental and physical condition, is deprived of a reasonable degree of benefit from the common schools."[30] Admission to the institution is obtained by application by parent or guardian or if a feeble-minded child is without either, by the board of supervisors, and it is made their duty "to make such application for any such child or youth who has no living, sane parent or guardian in this state, unless otherwise comfortably provided for."[31] The feeble-minded may also be sent, by order of the court, to a private institution caring for such persons.

While the institution as organized was primarily intended for children, subsequent legislation has authorized the admission of all feeble-minded men and women who are under forty-six years of age and residents of the State of Iowa.[32]

By an act of the Thirty-Eighth General Assembly (1919) all inmates of the institution for the feeble-minded are declared to be

wards of the state and when so committed can not be removed from the care of the institution without an order in writing from the board of control of state institutions.[33] Many detailed provisions describing the procedure by which a person may be declared feeble-minded by the courts, placed under guardianship, or taken into custody for care and maintenance are also included.[34]

The Epileptic. The object of the state hospital and colony for epileptics as stated in the code is to secure ''humane, curative, scientific and economical care and treatment of epileptics.'' Adults as well as children are admitted to the colony. Residence in Iowa for one year is necessary for admission.[35] Epileptics may be admitted as voluntary patients or may be committed by the commissioners of insanity in the same way that insane persons are committed to the state hospital for the insane.[36] The inmates of this institution are not declared to be wards of the state, but all persons admitted to the hospital and colony, even if sane, are under the custody and control of the superintendent who ''may restrain and discipline any patient in such manner as he may deem best for the welfare of the patient, subject at all times to such regulations as may be made by the board of control.''[37]

The Crippled. Another agency of the state for the care of defective children is the so-called Perkins Hospital for crippled children established in connection with the College of Medicine at the State University. At first the law provided only for the treatment of indigent children under sixteen years of age, but by an act of the Thirty-Eighth General Assembly, indigent persons over sixteen years of age may also receive such surgical and hospital care as they may need. In either case a formal hearing in court is prescribed before the court enters an order directing that the individual be taken or sent to the hospital for free medical and surgical treatment and hospital care.

In the case of a child under sixteen years of age, the judge may on his own motion appoint some physician to make an examination and report whether or not the child will probably be benefited by medical or surgical treatment; or such examination and report may be made upon complaint entered by any probation officer, school teacher or officer, superintendent of the poor, or licensed physician ''alleging that the child named therein is under sixteen years of age and is afflicted with some deformity or suffering from

some malady that can probably be remedied, and that the parents or other persons legally chargeable with the support of such child are unable to provide means for the surgical and medical treatment and hospital care of such child.''[38]

In case a cripple is over sixteen years of age the law provides that it shall be the duty of any ''physician, county supervisor, township trustee, public health nurse, overseer of the poor, policeman, priest or minister to report the same to the judge of the district or superior court having jurisdiction in the county in which said person resides.''[39]

In no case, however, will a minor child be ordered sent to the hospital without the consent of ''the parent, parents, or guardian or other person having the legal custody of such child.'' Nor is any person of full age and sound mind sent without his own consent.

The board of control of state institutions, however, may in its discretion send any inmate of any said institution, or any person committed or applying for admission thereto to the hospital for crippled children for treatment and care ''without securing an order from the court as provided in other cases.'' This was a part of the original act, when admission to the hospital was limited to those under sixteen years of age. Whether it would now apply to all inmates of the state institutions over sixteen years of age, is a matter for judicial interpretation.

The chapter dealing with children under sixteen years of age declares that: ''No child, under the terms of this chapter, shall be treated for any ailment except such as is described by the order of the court, unless permission for such treatment is granted by the parents or guardians; and no child shall be used for the purpose of experimentation.''[40] Again the law is silent as to whether this provision also applies to those over sixteen years of age.

3. *Delinquent Children.* The code treats neglected, dependent, and delinquent children in the same chapter, probably in recognition of the fact that neglect and dependency usually result in delinquency on the part of the child. While the laws requiring that children should be cared for and supported may not always be strictly enforced, the law-breaker soon gets into the hands of the law, and the law certainly recognizes the fact that juvenile delinquency and parental neglect are closely related. Section

2128 of the Compiled Code 1919 reads: "In every cause in the juvenile court the court shall investigate whether every person responsible for the care, custody, maintenance, education, medical treatment and discipline of the child or children involved, is doing his full duty by such child or children, and, in case the court finds that the parents or other persons *in loco parentis* are not doing their duties, the court shall try all lawful and proper means under this chapter to make them do so, giving them aid and assistance in case it be deemed necessary. The court may declare a child abandoned by one parent while it may not be by the other. In case the parents are divorced and the one having the custody is adjudged to have abandoned the child, then the ability and propriety of the other parent shall be considered."

The law as it relates to delinquent children applies to those under sixteen years of age who are not "charged with a commission of offenses punishable under the laws of the state with life imprisonment, or with the penalty of death." Delinquent children are defined as those under sixteen years of age who violate any law of the state or city ordinance or who are incorrigible; or who knowingly associate with thieves, vicious or immoral persons, or who are growing up in idleness and crime; or who knowingly frequent a house of ill fame; or who patronize any gambling resort; or who habitually wander about railroad yards or tracks or get upon moving trains or enter any car or engine without lawful authority.[41]

The district and superior courts are given jurisdiction in juvenile cases; a special juvenile court record being kept;[42] and "all such cases shall be tried to the court without a jury."[43]

To protect the juvenile offender from the disgrace of having been a 'jail bird," the law provides that no court or magistrate shall commit a child not yet having reached his seventeenth birthday, to jail or police station, but if such child is unable to give bail it may be committed to the care of the sheriff, police officer, probation officer, or other person who shall keep such child in some suitable place provided by the city or county, outside the inclosure of any jail or police station."[44] Moreover the judge is authorized to exclude from the court room, at time of hearing such cases, any and all persons who are, in his opinion, not necessary for the hearing of the case.[45]

Whenever a boy or girl is found guilty of the commission of a

crime, which is not punishable by life imprisonment or death, the court may instead of entering a judgment of conviction (1) continue the hearing from time to time, and may commit the child to the care or custody of a probation officer, and may allow the child to remain in its own home subject to the visitation of the probation officer, who may also require the child to report periodically to him, or (2) the court may cause the child to be placed in some suitable family home, or (3) the child may be committed to the proper training school, or (4) the child may be committed to any institution within the county incorporated under the laws in this state, that may care for delinquent children, or to any institution provided by a city or county, suitable for the care of delinquent children, or (5) to any state institution which may be established for the care of delinquent boys or girls over ten years of age. "In no case shall a child be committed beyond his or her minority."[46]

Juvenile Offenders. The definition of a juvenile delinquent in the section above indicates that there are two classes of such delinquents, namely, (1) those who violate any law of the state or city ordinance and (2) those whose habits, associates and environment are sure to lead to delinquency. Both of these two classes of juvenile delinquents are given the benefit of the juvenile court procedure, and instead of having a judgment of conviction entered against them, the court may dispose of the case as indicated above. The chapter of the code relating to the training-schools for both boys and girls, overlaps in part the law relating to juvenile delinquents just mentioned, the chief difference being that the former applies to children between the ages of ten and eighteen while the other applies to those under sixteen. In either case, however, the court may send such delinquents to the training-schools instead of entering a judgment of conviction. The law relating to the commitment of children to the training-schools reads as follows: "When a boy over the age of ten years and under eighteen, or a girl over the age of ten years and under eighteen, of sound mind, excepting married women, prostitutes, or any girl who is pregnant, shall be found guilty in any court of record of any crime excepting that of murder, the court in its discretion may, instead of entering judgment of conviction, order and direct the party to be sent to the training-school."[47]

On complaint of parent or guardian that any boy or girl over ten

years and under eighteen ''is habitually vagrant, disorderly, or incorrigible,'' the child may with the consent of the parents or guardian be committed to one of the training schools, ''for reformation and instruction until he or she attains the age of twenty-one years,'' and no commitments may extend beyond twenty-one years.[48]

If persons committed to the training-schools are incorrigible, or if their presence is detrimental to the welfare of the school, they may be returned to the county of their residence ''where proceedings shall be resumed as if no committal had been made.''[49]

Boys or girls committed to the training-schools may be placed under contract ''with any persons or in any families of good standing and character where they will be properly cared for and educated,'' but not ''beyond the time when the persons bound shall attain their majority.''[50]

The chapter on the Women's Reformatory again deals with delinquent girls and provides that females under the age of sixteen years of age and over twelve convicted of offenses punishable by life imprisonment, may be committed either to the training-school or to the Women's Reformatory as the court may see fit.[51] Other females convicted of a felony and sentenced to confinement in the penitentiary are kept in the Women's Reformatory, and ''justices of the peace and judges of the police courts throughout the state may commit all females sentenced to thirty days to such reformatory.''[52]

Any girl over fourteen years of age who is an unruly and incorrigible inmate of the training-school for girls, may be transferred to the Women's Reformatory.[53]

The city is no doubt the home of many of our juvenile delinquents, and special provision has been made for their detention and care while under arrest. In all cities of 25,000 or more inhabitants the mayor is required to designate one or more station-houses for the detention or imprisonment of women and children under arrest and he must see that the rooms or cells set apart for them are separated from and out of sight of the rooms or cells in which male prisoners are imprisoned.[54] Cities may also maintain ''a house of refuge, or a house of correction and a work-house, or either of them.'' For the violation of any city ordinance, children under sixteen may be committed to the city house of refuge, if over six-

teen to the house of correction and work-house.[55] In cities of 25,000 or more inhabitants, the mayor may, and in cities of 35,000 or over he must appoint, for each station-house provided for the detention of women and children, one or more women police matrons who must be residents of the city and over thirty years of age.[56] Police matrons so appointed have charge of all women and children under arrest and accompany such as may require aid to court.[57]

VI. THE PROTECTION OF THE HEALTH AND MORALS OF CHILDREN

The state has not considered its duty complete when it has porvided that a child is entitled to sustenance. In addition, numerous provisions are found in the code which have for their object the protection of the health and morals of the child.

Section 885 declares that ''no person under sixteen years of age shall be employed at any work or occupation by which, by reason of its nature or the place of employment, the health of such person may be injured, or his morals depraved, or at any work in which the handling or use of gunpowder, dynamite or other like explosive is required, or in or about any mine during the school term, hotel, bowling alley, pool or billiard room, or in occupations dangerous to life or limb, and no female under twenty-one years of age shall be employed in any capacity where the duties of such employment compel her to remain constantly standing.'' Moreover the baneful effects on children of tender age, and especially on girls, of being engaged in any of the street occupations of peddling, boot-blacking, and selling papers is recognized.[58]

Fixing the hours of labor for children under sixteen between seven A. M. and six P. M. with a noon intermission of at least thirty minutes must be looked upon as a health measure.[59]

The prohibition of the sale or gift of intoxicating liquors to minors is no doubt designed both for the protection of health and morals.[60] Likewise the section which makes it ''unlawful for any person under the age of twenty-one years to smoke or use a cigarette or cigarettes on the premises of another, or on any public road, street, alley or park, or other lands used for public purposes or in any public place of business or amusement, except when in company of his parent or guardian,'' is no doubt intended as a health measure.[61]

The provision of the law already recited for the giving of free medical, surgical, and hospital treatment to indigent children may be looked upon as a measure to protect the health of such persons. The requirement that physicians, parents, guardians, or school teachers report cases of whooping-cough, measles, mumps or chicken-pox to the local board of health,[62] and the placarding of the homes of children so afflicted, as a public warning, no doubt tends to reduce the spread of such diseases.[63]

Moreover in all cases of dependency or delinquency in the juvenile court "the court may, when the health or condition of the child may require it, cause the child to be placed in a public hospital or institution for treatment or special care, or in a private hospital or institution which will receive it for like purposes without charge."[64]

The presentation of immoral plays, exhibitions, and entertainments "which would tend to the corruption of the morals of youth or others" is made a misdemeanor punishable "by a fine not exceeding one thousand dollars or imprisonment in the county jail not exceeding one year or by both such fine and imprisonment."[65] In addition, any person who leases or lets his premises for such purposes is likewise subject to the same penalty.

Other provisions intended to protect the morals of the youth forbid the exhibiting of pictures of prize fights, printing or circulation of obscene books, pictures or literature, or the use of obscene productions by phonograph, or the exhibition of deformed or abnormal persons.[66]

VII. CRIMES AGAINST CHILDREN

Closely related to those provisions designed to protect the health and morals of the youth are those declaring certain actions in relation to children as criminal. These actions may be classified into three groups: (1) Desertion or abandonment of children, (2) child stealing, and (3) sex crimes.

1. *Desertion or abandonment of children.* Anyone who exposes a child under six years of age on the highway, in a field or in any other place with the intent wholly to abandon it, is subject upon conviction to imprisonment in the penitentiary for not over five years.[67] In like manner any one who abandons "his or her legitimate or legally adopted child or children under the age of sixteen

years, leaving such child or children in a destitute condition, or shall, without good cause, wilfully neglect or refuse to provide for such child or children they being in a destitute condition, shall be deemed guilty of desertion and, upon conviction, shall be punished by imprisonment in the penitentiary for not more than one year, or by imprisonment in the county jail for not more than six months.''[68] Persons so convicted, however, may be released by giving bond guaranteeing to ''furnish his or her child or children with a necessary and proper home, food, care and clothing.''[69]

2. *Child stealing.* In addition to the provision against kidnaping, a special section on child stealing is found in the code. This section on child stealing provides that any one who takes or entices away any child under the age of sixteen years ''with intent to detain, or conceal such child from its parents, guardian, or other person or institution having the lawful custody thereof,'' may be punished by a period of imprisonment not exceeding one year or fined not exceeding one thousand dollars.[70]

3. *Sex Crimes against Children.* A punishment of three years in the penitentiary may be imposed upon any one who entices any female into a house of ill fame for the purpose of prostitution, but a five-year sentence may be imposed on one who entices an unmarried female under eighteen years of age away for such a purpose.[71] The maximum punishment for rape is life imprisonment and the carnal knowledge of any female child under fifteen years of age is defined as rape; thus placing the age of consent at fifteen years of age.[72] Moreover, any lewd, immoral, or lascivious act upon or with the body of any child under thirteen years of age by one over eighteen years of age is punishable by a term of not more than three years in the penitentiary or by a fine of not over five hundred dollars.[73]

VIII. THE EDUCATION OF CHILDREN

Not only does the child in Iowa have a right to a common school education up to his sixteenth year, but he is compelled by law to have it unless physically or mentally incapacitated from attending school.[74] Moreover truant officers may be provided whose duty it is to apprehend and take into custody children of school age who are found loitering about during school hours.[75] In addition school boards are authorized to establish truant schools for the

instruction of children who are habitually truant, and may provide for their confinement, maintenance, and instruction under reasonable rules and regulations. The child who proves to be insubordinate or who escapes from the school during school hours may be adjudged disorderly and incorrigible and be committed to one of the training-schools of the state.[76] In the training-schools the child finds that the state has provided that he "be instructed in piety and morality, in such branches of useful knowledge" as are adapted to his age and capacity, and "in some regular course of labor, either mechanical, agricultural or manufactural." He is also to be given instruction "in physiology and hygiene with special reference to the effect of alcoholic drinks, stimulants and narcotics upon the human system."[77]

Dependents and delinquents in the Juvenile Home are to be given "instruction in common school and higher branches, science and arts, so far as practicable, and in such manual training as shall best physically and otherwise develop and fit such inmates to become good citizens."[78] Schools are also provided in county detention homes for children when established.[79]

In the Soldiers' Orphans' Home the children must be given "a common school education."[80] Even the poor children at the county home or poor farm must "attend the district school for the district in which such home is situated."[81]

There is no escape from a common school education in Iowa according to law; for "any person having control of any child of the age of seven to sixteen years, inclusive, in proper physical and mental condition to attend school, shall cause such child to attend some public, private, or parochial school, where the common school branches of reading, writing, spelling, arithmetic, grammar, geography, physiology, and United States history are taught." A failure to send a child to school as provided subjects the individual having control of the child to a penalty of from three to twenty dollars for each offense.[82]

School boards are authorized to establish evening schools for the benefit of those over sixteen years of age who from any cause are unable to attend the public day schools.[83] Moreover, when ten or more such persons desire instruction it is made the duty of the school board to "establish and maintain an evening school for such instruction throughout a period of not less than three months of

every school year and for not less than two hours at least two times each week during the term of such evening school.''[84]

School boards are also permitted to organize part time vocational schools for children, between fourteen and sixteen years of age who hold work certificates, or who have not completed the eighth grade, and whenever there are fifteen or more such children in a district it is mandatory upon the school board to organize such part time schools.[85]

Thus we have seen that the state not only provides for, but requires the education of all normal children including both the dependent and the delinquent. Nor can the defective escape. Compulsory education of the deaf and the blind is required by law,[86] and the feeble-minded and the epileptic are given such education as they are capable of receiving.[87]

The percentage of illiteracy in Iowa is very small which testifies to the faithful administration of the school laws.

IX. THE LEGAL RIGHTS OF THE CHILD

The child as a person in law is entitled to many of the same legal rights as the adult. In this paper, however, only those acts, in which the child is specially mentioned will be considered.

In the first place there is a recognition of the child's right to be born alive and a heavy penalty rests upon anyone who would attempt to prevent it.[88] When born, the date of his birth and his name are matters of public record.[89]

It is a well known fact that a minor does not enjoy the same degree of freedom in all matters that the adult does. The law declares that the parents are the natural guardians of their minor children and are equally entitled to their care and custody.[90] If a child has no natural guardian, the court may appoint one, and in all cases where a minor owns property a guardian must be appointed, because a minor is under restrictions in regard to property matters.[91] A minor over fourteen years of age and of sound mind may select his own guardian.[92] A guardian stands in the same relation to a minor as a parent would if living.

There is a rather strong popular belief that contracts made by minors are void. The law, however, declares that ''a minor is bound not only by contracts for necessaries, but also by his other contracts, unless he disaffirms them within a reasonable time after

he obtains his majority, and restores to the other party all money or property received by him by virtue of the contract, and remaining within his control at any time after his attaining his majority,''[93] except that where a minor misrepresents his age or engages in business as an adult he can not disaffirm his contracts if the other party had good reason to believe him capable of contracting.[94]

In case of a contract for the personal services of a minor, when made with him alone, and when payment for the service rendered is made to him in accordance with the terms of the contract, the parent or guardian can not recover such child's wages a second time[95] on the ground that a parent is entitled to the wages of his minor children. Nor can a parent claim the earnings of a child who has been placed out by adoption or for a term of years by the Juvenile Home.[96]

Minors may sue and be sued but ''the action of a minor must be brought by his guardian, if he has one, if not, by his next friend, but the court may dismiss it if it is not for his benefit, or may substitute a guardian or another person as next friend.''[97]

On the other hand ''the defense of a minor must be by his regular guardian, or by one appointed to defend for him where no regular guardian appears, or, where the court directs a defense, by one appointed for that purpose. No judgment can be rendered against a minor until after a defense by a guardian.''[98]

X. THE PROPERTY RIGHTS OF A CHILD

Legal rights and property rights are necessarily so closely related that the writer made no attempt to draw a sharp line of distinction between them. While all children may be said to have legal rights, property rights pertain to those having property or a claim to property.

The law of Iowa distinctly gives a child a right to inherit from his parents, if they die intestate. In this case two-thirds of the estate goes to the children and one third to their mother if living, otherwise all of the estate would go to the children. Even a posthumous child is entitled to his proportional share of his father's estate.[99]

Whenever a parent has been adjudged guilty of contributing to the dependency of a child and the child is subsequently adopted as

provided by law, such adoption "shall not prevent or cut off any inheritance he might be entitled to from his rightful or adoptive parents adjudged guilty of contributory dependency, ... in accordance with the laws of descent of this state, such inheritance to be in addition to that to which he may be entitled by virtue of the adoption hereunder and no will to the contrary shall be valid."[100]

The whole law of guardianship is chiefly concerned with conserving the property rights of minors.[101] Numerous special provisions are found for the protection of their property interests.[102] Thus a way is provided by law for the redemption of the property of minors when sold for taxes, as well as for guarding their other property rights.[103]

The property rights of adults are also protected against criminal acts of children by authorizing cities and towns to prohibit pawnbrokers and junk or second-hand dealers from purchasing or receiving from minors any property without the written consent of their parents or guardians.[104]

Under the workmen's compensation act any child under sixteen years of age is entitled to compensation for the loss of a parent according to the schedule provided in the law.[105] Payments, however, are made to a trustee appointed by the judge of the district court who must spend the money received "for the use and benefit of the person entitled" to it. The same is true where the minor receives compensation for injuries sustained.[106] A parent may also "maintain an action for the expenses and actual loss of service resulting from the injury or death of a minor child."[107]

XI. THE CHILD IN INDUSTRY

Child labor has been the curse of industry. Greedy and needy parents have forced children of tender age into the work shop and the factory for the sake of helping out the family income or even for the purpose of relieving the parent of labor. Industry has often been a willing partner to the sacrifice of child life to increased dividends. In almost every state in the Union there has been a struggle at one time or another to define the status of the child in industry, to give it the protection necessary to enable it to acquire at least a common school education, and to maintain its health, morals and well-being.

Although Iowa is not rated as an industrial state, there are nevertheless many opportunities for the exploitation of the child unless it is protected by law. That the child labor laws of Iowa do afford protection is shown by the fact that Iowa ranks high among states that are concerned with the interests of childhood.

There are a number of provisions in the code limiting occupations solely on the ground of age. Thus provision is made in section 860 that "no person under sixteen years of age, and no female under eighteen years of age shall be permitted or directed to clean machinery while in motion. Children under sixteen years of age shall not be permitted to operate or assist in operating dangerous machinery of any kind."

Section 882 is the chief section defining the status of the child in industry. This section provides that "no person under fourteen years of age shall be employed with or without wages or compensation in any mine, manufacturing establishment, factory, mill, shop, laundry, slaughter house or packing house, or in any store or mercantile establishment where more than eight persons are employed, or in the operation of any freight or passenger elevator, or livery stable or garage, place of amusement, or in the distribution or transmission of merchandise or messages. Provided that nothing in this section shall be construed as prohibiting a child from working in any of the above establishments or occupations when such are owned or operated by their own parents."

No person under sixteen years of age can be employed in any of the places or occupations enumerated above before seven o'clock in the morning or after six o'clock in the evening, and if the employment exceeds five hours a day then a noon intermission of at least thirty minutes must be given. Nor can such persons be employed more than eight hours in any one day, exclusive of the noon intermission, nor more than forty-eight hours in any one week; but if a part time school is organized in the district, then no one under sixteen years of age can be employed more than forty hours in any one week.[108] It is also incumbent upon any one employing children under sixteen years of age to keep duplicate lists of the names and ages of all such children together with their work permits accessible to any officer charged with the enforcement of the child labor laws. Work permits are granted only through the school authorities and must show that the child is fourteen years

of age or over, and is sufficiently sound in health and physically able to perform the work for which the permit is sought. The school record of the child must also show that it has completed "a course of study equivalent to six yearly grades in reading, writing, spelling, English language, geography, and arithmetic."[109]

The health and morals of the youth are protected by a section previously cited.[110]

Another section prescribing working conditions for children applies only to cities of ten thousand or more inhabitants. This section provides that "no boy under eleven years of age nor girl under eighteen years of age shall be employed, permitted or suffered to work at any time in any city of ten thousand or more inhabitants within this state in or in connection with the street occupations of peddling, boot-blacking, the distribution or sale of newspapers, magazines, periodicals or circulars, nor in any other occupations in any street or public place; except that in cities having a superior or municipal court, the superintendent of schools or person authorized by him, upon sufficient showing made by the said superior or municipal judge, shall have authority, in exceptional cases, to issue a permit to a boy under eleven years of age." The section then goes on to describe the conditions under which a work permit will be issued, provides for the issuance of a badge to be worn by such boys which will authorize them "to engage in the above mentioned occupations at such time or times between four A. M. and seven-thirty P. M. in each day as the public schools of the city or district where such boys reside are not in session, but at no other time, except that during the summer school vacation, such boy may engage in such occupation until the hour of eight-thirty P. M." Penalties are put upon parents or guardians of children who engage in street occupations in violation of this section; also upon persons who sell articles to such children to be resold.[111]

A part of section 886 seems to be in direct conflict with section 884 just given for it provides that no "person under eighteen years of age (shall) be employed in the transmission, distribution or delivery of goods or messages between the hours of ten in the evening and five in the morning in any city of ten thousand or more inhabitants."

Attention has already been called to the provisions for the estab-

lishment of part-time schools for minors between the ages of fourteen and sixteen years of age holding work certificates.

It is made the duty of the commissioner of the bureau of labor statistics to enforce the provisions of the child labor laws.[112] One of the factory inspectors must, according to law, be a woman whose special duty it is to "inspect the sanitary and general conditions under which the women and children are at work in all factories, work shops, hotels, restaurants, stores, and any other places where women and children are employed."[113]

In the coal mining industry the mine foreman or pit boss must keep a record of the boys under sixteen years of age employed by him during school vacations. This record must show their names and ages, names and residence of parent or guardian and the character of the employment in which they are engaged. This record must be open to inspection at all reasonable times.[114]

XII. SPECIAL RESTRICTIONS UPON MINORS

The mature and normal person finds that the numerous legal restrictions he must comply with have been enacted in the interest of public welfare. The minor, however, finds numerous legal restrictions imposed upon him which are intended to a large extent to protect him against his own immature judgment.

These restrictions may readily be classified into two groups, namely: those that are absolute and those which may be overcome by the consent of parent or guardian.

In the first class should be mentioned the inability of a minor to vote, to sit on a jury, or to hold public office. Nor is the marriage of a boy under sixteen and a girl under fourteen valid.

The right to sue and to be sued in his own name, in civil action, is a right only of a mature person of sound mind.[115] Numerous special provisions for the trial and detention of youthful offenders are, however, found, and have already been referred to.

The numerous restrictions in the labor laws limiting the right of occupation or employment under certain ages are absolute in the sense that they may not be removed by parental consent.

Recognizing that fire arms in the hands of immature persons are dangerous not only to such persons but also to others, the law prohibits any one from selling or giving to a minor "any pistol, revolver or toy pistol."[116]

The second group includes those restrictions which may be overcome by parental consent.

Boys of sixteen and girls of fourteen may marry but only with the written consent of their parents or guardian.[117] The right of the parent to consent to the marriage of such immature persons has been seriously questioned.

Laws prohibiting the youth from enjoying the vices of mankind are, like our Sunday observance laws, "more honored in the breach than in the observance," yet these laws are still on the statute books. One of these laws declares that "no person by himself, agent or otherwise, shall in any manner procure for, or sell or give any intoxicating liquors to any minor for any purpose, except upon written order of his parent, guardian, or family physician."[118] Since Federal prohibition has rendered the written order of parent, guardian, or family physician of no value, this law is now, probably, well observed. Another act, violations of which may be seen any day, provides that "it shall be unlawful for any person under the age of twenty-one years to smoke or use a cigarette or cigarettes on the premises of another, or on any public road, street, alley or park or other lands used for public purposes or in any public place of business or amusement, except when in company of his parent or guardian."[119]

Two other restrictions are placed upon minors because of immature judgment. The first denies any one under eighteen years of age the privilege of getting a hunter's license "unless the written consent of parents or guardian is attached to the application."[120] The other forbids persons under fifteen years of age from operating or driving a motor vehicle even with the permission of the owner unless "accompanied by a person of mature years," and even then the owner of the car is held liable for any damage done.[121] A chauffeur's license may not be issued to any one under eighteen years of age, and those over eighteen and under twenty-one who apply for such licenses must have their parents or guardian join in such application by signing the same. Then "any negligence of a minor, so licensed, in operating a motor vehicle upon the public highway, as chauffeur, shall be imputed to the person, persons or corporation, who shall employ said chauffeur; which person, persons, or corporation . . . . shall be jointly and severally liable with such minor for any damage caused by such negligence."[122]

The right of cities and towns to prohibit pawn-brokers, junk dealers, and second-hand dealers from purchasing or receiving any property from a minor without the written consent of their parents or guardian has already been noted.

XIII. CHILD WELFARE LEGISLATION

In a broad sense most of the legislation already described may be designated as child welfare legislation. The state has been ready and willing to give the aid which legislation affords for the benefit of the dependent, the defective and the delinquent. In fact it has been frequently stated that while these classes of children were being materially cared for, the interests of the normal child were really neglected. To promote the interests of the normal child and disseminate the information acquired by investigation and research the Iowa Child Welfare Research Station was established in 1917, under authority of an act of the Thirty-Seventh General Assembly.

The management and control of the Station is vested in a Director, appointed by the Iowa State Board of Education. The sum of $25,000 annually was appropriated for the maintenance of the Station which is located at Iowa City "as an integral part of the state university."[123]

Child welfare in a popular sense has been made a part of the program of our municipal social and recreational activities. Cities of more than fifty thousand inhabitants may provide a "Community Center House" in one or more districts of the city for the promotion of child welfare, among other things.[124]

In other cities the council may appoint a "Community Civic Congress," the chief function of which is to advise and coöperate with the council "in all matters pertaining to community improvements, child welfare, and social and recreational activities."[125] In either case child welfare is probably limited to furthering of wholesome social and recreational activities for the children of the community.

XIV. CONCLUSION

The purpose of this paper, as already stated, was to give a narrative account of the laws of Iowa relating to children. The fact that these laws are so widely scattered throughout the new com-

piled code has convinced the writer of the desirability of codifying these laws. The laws of Iowa relating to children are, like those of many other states, largely patches upon other statutes. They represent the legislative action of many assemblies, and it is not surprising to find that they have not been passed with any definite unity of purpose. Some of our legislation is no doubt up to the best standards of child welfare legislation, but at the same time conflicting, indefinite and obsolete acts still abound.

A few examples will suffice for illustration. To find the responsibility of a parent for the care and support of his children it is necessary to consult the law of domestic relations, the poor laws, the labor laws, the school laws, and perhaps others. In one place the law relative to delinquent children states that no child under seventeen years of age can be put in jail; while in another place provision is made for the detention of children both over and under sixteen years of age in rooms or cells separate from and out of sight of adult prisoners.

Again the law says that no commitment of a delinquent boy or girl shall extend beyond his or her minority; and another section provides that boys and girls shall not be committed beyond their twenty-first year.

In one place the law declares that a child whose parents have no settlement in this state gains a settlement by residing in any county of the state for one year. In another place it provides that any child brought into this state by a Home-finding Association who becomes a public charge within five years must be removed from the state by such association.

One section of the labor laws forbids any person under eighteen years of age engaging in the distribution or delivery of goods or messages between 10 P. M and 5 A. M., and yet another section permits boys over eleven years of age to engage in street occupation between 4 A. M and 7:30 P. M.

The law relative to the registration of births is almost universally declared to be inadequate both as to substance and administration. Adequate definitions of terms, and administrative machinery for the enforcement of the law are pressing needs. The substance of the law is no doubt of prime importance, but laws are not self-enforcing and without efficient administration laws soon become a dead letter.

At the present time it is no doubt difficult for one inexperienced in the reading of statutes to find many of the provisions of the law relating to children, even with the superior index of the compiled code of 1919. It is therefore the opinion of the writer that Iowa should join in the march of progress and provide for a children's code commission to revise and unify our laws relating to children.

Children's Code Commissions have been established in Connecticut, Delaware, Indiana, Michigan, Missouri, Minnesota, Montana, Nebraska, New Hampshire, Ohio, Oregon, South Carolina, and Wisconsin. In some of these states children's codes have already been adopted; in others the commissions are still at work.

There is a common belief that the problems of child welfare are mostly municipal, yet the Missouri Children's Code Commission found them to be rural and not municipal. Investigation might prove the same to be true in Iowa. A revision and codification of our laws relative to children should be undertaken at an early date in order that the best standards of child care may be adopted for this state in the interest of good citizenship.

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FIRST SERIES No. 53 SEPTEMBER 1, 1921

UNIVERSITY OF IOWA STUDIES

STUDIES IN CHILD WELFARE

VOLUME I NUMBER 7

SELECTIVE MIGRATION AS A FACTOR IN CHILD WELFARE IN THE UNITED STATES

WITH SPECIAL REFERENCE TO IOWA

BY

HORNELL N. HART

PUBLISHED BY THE UNIVERSITY, IOWA CITY

Issued semi-monthly throughout the year. Entered at the post office at Iowa City, Iowa, as second class matter. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on July 3, 1918

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FROM THE IOWA CHILD WELFARE RESEARCH STATION

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FOREWORD

This investigation directs attention primarily to the movements of population which produce fundamental modifications in parent stock with resultant effects on *child welfare.* The *Study* is a condensed form of a dissertation presented by the author in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Child Welfare. In his work under my direction Dr. Hart has had the coöperation of Associate Professor Clarence M. Case of the Department of Sociology, and Professor Henry L. Rietz, Head of the Department of Mathematics.

There is an increasing recognition of the fact that rural communities in the East have become to a considerable extent decadent. A similar situation is found in Ohio and Indiana and other sections of the Middle West. Sociologists have ascribed this situation to the type of migration which has been going on from these states. The present investigation aims to determine objectively the extent and significance of such migration in Iowa. In order to approach the problem from an empirical, scientific point of view, it was necessary to develop new methods of measuring migration, of determining fecundity, and of analyzing the predominant characteristics of migrants.

Two lines of action are recommended by the author: "The first is to seek to decrease the emigration by measures calculated to make rural Iowa attractive to the type of parents which it is desired to retain."

"A second line of action is the taking of measures calculated to counteract the dysgenic influence of emigration by a more rapid multiplication of desirable types of parents and less rapid multiplication of the undesirables. Personally the author believes that this is the more hopeful course. Details as to measures under this head must wait for presentation until a later publication."

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ACKNOWLEDGMENTS

In addition to the members of the University faculty who have given assistance in the preparation of this study acknowledgments are due to Professor Edward Alsworth Ross for the original suggestion of the study of the character of American pioneers (Chapter III), to Dr. Franklin Johnson, and to my father, Dr. Hastings H. Hart, for constructive criticisms, and to Miss Ione Bliss for assistance with references.

I. CHILD WELFARE AND SELECTIVE MIGRATION

1. THE PARENT AS A FACTOR IN CHILD WELFARE

Interstate migration of a selective character is occurring in the United States on so vast a scale as to menace such communities as the rural districts of Iowa with serious deterioration in the quality of the parenthood of future generations. The present inquiry is devoted to the development of this thesis.

As a matter of classification, the elements entering into the welfare of children may be grouped under two heads: first the factors which the parents transmit, control or select; and second the factors which are determined independently of the parents. Under the first head come the factors determined in the germ plasm, the factors determined by the prenatal environment, and the factors in the early postnatal environment controlled or selected by the parents. In addition to these there must be considered under this head the factors in the juvenile environment subject wholly or in part to control by the parents collectively, such as the quality of the school system. Under the head of factors determined independently of the parents must be grouped, for a given community, environmental elements such as the available natural resources, the climate, the cost of the necessities of life, the general level of wages, and the like. A large proportion of the juvenile environment lies in the twilight zone between control by the parents and independence of the parents. Housing conditions and the quality of available recreation are illustrations. The present inquiry is concerned only with factors in child welfare which are transmitted, controlled or selected, wholly or in part, by the parents individually or collectively—which, in other words, depend wholly or in part upon the quality of the parents. Obviously those aspects are highly important, including as they do not only all hereditary factors, but also an important portion of the environment.

2. MIGRATION AND THE QUALITY OF PARENTS

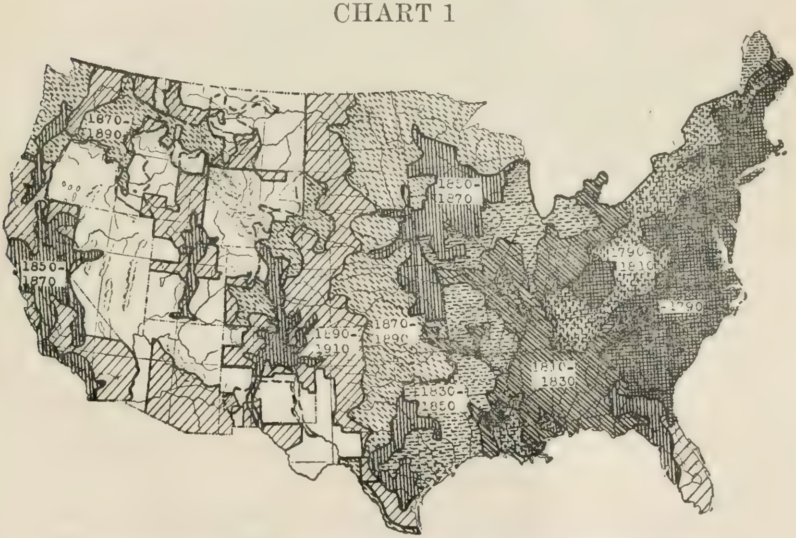
The field of inquiry of the present study is restricted still further. The quality of the parenthood of the children in a given area is determined by factors which may be classified as follows: the characteristics of the original potential parents who settled the area; the extent and character of subsequent migration of potential parents into and out of the area; the influence of the local environment, physical and social, upon the settlers in the area; and the relative rates at which various types of potential parents in the area bear and rear children. The present inquiry is concerned primarily with the influence of migration upon the character of the parenthood in the United States with special reference to Iowa. Secondarily, in a negative way, the inquiry is concerned with the influence of local environments upon migrants as an alternative to migratory selection in explaining the characteristics of early settlers. With the relative rates at which various types of potential parents bear and rear children the present study is concerned only in respect to the fecundity of migrants as compared with non-migrants. The general question of the correlation between fecundity and parental desirability must be considered in a separate study.

II. THE EXTENT OF MIGRATION IN THE UNITED STATES; AGE, COLOR AND NATIVITY

3. THE EXTENT OF MIGRATORY MOVEMENTS IN THE SETTLEMENT OF THE UNITED STATES

Since 1776 over 33,600,000 persons born in other countries have migrated into the United States, (*114-128*). The progress of the settlement of the United States is shown in Chart I. This map presents, at the twenty-year intervals indicated, the outlying boundaries between the areas having over two persons per square mile, and the areas having a lower density. In 1790, it will be noted, only the section east of the Alleghany Mountains had a

CHART 1



THE MOVEMENT OF THE FRONTIER ACROSS THE UNITED STATES

Zones in which the density of population increased from less than two persons per square mile to more than that number in each of the 20-year periods from 1790-1910. For the sake of simplicity unsettled sections which were entirely surrounded by settled sections are considered as being settled. Areas settled in 1890 and depopulated before 1910 are not shaded. Sources of data *120* opposite pp. xii, xiv, xvi, xix; *125* opposite p. 2; *122* plate viii.

population of two or more persons per square mile. The rest of the United States, except for an area in the Ohio Valley, was practically unsettled. By 1810 the pioneers had pushed the frontier to the shores of Lake Huron and Lake Erie, had advanced down the Ohio Valley part way through Tennessee, and had begun to move up the Mississippi from its mouth. In 1830 the settlers had occupied the eastern part of the Mississippi Valley and had pushed pseudopodia of population up various branches of the Mississippi. Florida and certain sections on the gulf where still unsettled. The 1850 frontier had advanced further up the rivers. In 1870, in addition to a continuation of the advance up the tributaries of the Mississippi, the settlement of California had begun, and a settlement had been made in the mountains of the south-west. By 1890 the frontier had been advanced on all fronts, and a settled area had started in Utah. In 1910 the unsettled regions consisted chiefly of desert and mountain land.

4. THE EXTENT OF RECENT MIGRATION

It is ordinarily assumed that native migration is a factor of diminishing importance in the United States. It is startling, therefore, to note that in 1910, (*125*, p. 689) over one-fifth of the native-born persons in the United States were natives of other states than those in which they were living. This percentage is greater than in 1900 or 1890, and practically as large as in 1870 and 1880. The *number* of native-born persons living in states other than the states of their birth was more than twice as large in 1910 as in 1870. The extent of migration as a factor in the make-up of population in recent years is suggested by Table 1.

5. PAST METHODS OF MEASURING MIGRATION

In view of the vast extent of migration, and in view of its possibly profound effects upon the character of the parenthood of future generations it is important to have some means of measuring accurately the numbers of persons of various ages and nativities who are migrating out of and into various sections of the United States. Three different methods have been used chiefly in the past for measuring or indicating the extent of migration. The first utilizes gross increases and decreases in population. (As examples see *137* and *142*). This measure is unreliable because not only migration but also death and birth rates help to deter-

TABLE 1

MIGRATORY MAKE-UP OF THE POPULATION OF THE UNITED STATES 1870-1910

Sources of data *125*, pp. 129, 689

Census	Total population (includes birth place unknown)		Born in state of residence	
	Number	Per cent	Number	Per cent
1910	91,972,266	100.0	61,185,305	66.5
1900	75,994,575	100.0	51,901,722	68.3
1890	62,947,714	100.0	41,871,611	66.5
1880	50,155,783	100.0	33,882,734	67.5
1870	38,558,371	100.0	25,321,340	65.6
Census	**Born in other parts of the United States**		**Foreign-born**	
	Number	Per cent	Number	Per cent
1910	16,910,114	18.4	13,515,886	14.7
1900	13,501,045	17.8	10,341,276	13.6
1890	11,094,108	17.6	9,249,560	14.7
1880	9,592,764	19.1	6,679,943	13.3
1870	7,657,320	19.9	5,567,229	14.4

mine population changes. A locality may be increasing in population in spite of a large amount of emigration, and it may be decreasing in spite of immigration. A second method is the direct enumeration of migrants, including the two sub-methods of enumerating immigrants and emigrants at national frontiers, and of enumerating persons at census periods according to place of birth and date of migration. Both of these sub-methods are in use in the United States. (*125* pp. 689, 1017f; *128*; See also *148*). Enumeration at frontiers gives no reliable indication of the ultimate destination of the immigrant within the country, and gives no data as to the number of migrants surviving at a given date. Census enumerations of foreign immigrants afford no method of telling how many foreigners who were in the country before the preceding census left the United States later. Census enumerations of natives by states of birth are not classified according to age, and do not give the dates at which migration occurred. The third general method of measuring migration is to subtract from the increase in population of a given territory during a given period the natural increase, that is the excess of births over deaths during the period. (*134*; *138*; *139*; *145*). The difficulties in applying this method to the United States are that it involves very complicated estimates of birth and death rates, and that it does not show the age distribution of the migrants.

6. THE AGE-DISTRIBUTION METHOD

ESSENTIAL THEORY

The method evolved by the present writer for measuring migration requires as its only materials accurate data as to the age distribution at successive censuses of the groups to be studied and as to their death rates by ages. No data as to birth rates, foreign immigration, emigration, and the numerous details related to them are required. The results achieved by this method have the additional advantage of indicating the age distribution of the migrants.

The method is based upon the following definitions. A resident of a community, for the purposes of this study, is an individual subject to census enumeration as a unit of the population of that community. A migrant into a community is any individual who becomes a resident of that community in any other way than by being born in it. A migrant out of a community is any individual who has been a resident and who ceases to be a resident in any other way than dying in it. It follows from these definitions that if the number of residents of a given age in a given community at a given date be known, and if it can be accurately estimated how many of these residents died during the next 10 years, and how many persons there were in this same community 10 years later who were 10 years older than this group was at the first date, it is simply a matter of addition and subtraction to determine the net surviving migration, during the 10 year period, of individuals in this age group. For the sake of simplicity the number of surviving migrants is calculated instead of the total number of migrants; that is to say, not only the individuals who died in their original place of residence, but also the individuals who died before the next census in communities to which they had migrated are eliminated in the calculations. The principle may be put into algebraic terms as follows:

Let a = the date of a given census.
Let b = the date of the succeeding census.
Let p_a = the number of individuals in a given age group as reported in census a.
Let p_b = the number of individuals of ages (b-a) years greater than the p_a group, as reported in census b.
Let d = the number of deaths among the p_a individuals during the interval between the censuses.

Then, $p_a - d$ = the number of individuals who would survive out of the p_a group at the time census b was taken.

And $p_b - (p_a - d) = p_b - p_a + d$ = the net number of migrants of this age group into the territory during the interval between the two censuses.

It is the method thus formulated which is applied throughout this study in measuring migration. In order to determine the influence of foreign immigration by this method the foreign-born are simply treated as a separate group. Similarly negro migration is measured independently of white, and native whites of native parents are considered separately from native whites of foreign parents. In order to study migration between rural and urban districts, the districts are considered separately. In order to determine the extent of native emigration from the United States, the same method is applied to native whites and negroes for the country as a whole.

Method of Securing Classified Age Distribution

For the purposes of the present investigation the source which supplies the most suitable data as to age distribution is Table 48 in Volume I of the 1910 census, entitled ''Distribution by Broad Age Periods of the Combined Population in Cities of the Specified Classes, By Divisions: 1910, 1900, and 1890.'' (*125* pp. 432-436). Unfortunately this table, because of deficiencies in the 1890 census, does not separate cities under 25,000 from rural territory, but this defect seems unavoidable if comparable data for the two decades are to be secured. The table is defective for the present purposes in two other respects, for which corrections have been made: first, the table classifies persons over 24 years of age into 20 year groups, whereas for the present purpose the returns had to be subdivided by interpolation into 10 year groupings; second, the table gives the returns for cities of the various classes according to the status of those cities at each census, so that it was necessary to subtract from the urban totals at the end of the decade the population of cities which passed the 25,000 line between censuses, and to add these amounts to the rural totals. Similar corrections are necessary between the group of small cities and that of large.

The data used exclude Chinese, Japanese, and Indians and their migrations have not been measured in this study.

Methods of Securing Corrected Classified Death Rates by Ages

The most authoritative source of information as to death rates by ages for the groups involved is contained in Glover's *United States Life Tables* prepared for the Bureau of the Census (*106*). These tables give death rates by ages in 1910 for urban whites, rural whites, and negroes. It would not be accurate to assume, however, that the death rates of urban whites at a given age are valid for both foreign-born and native-born whites of the same ages in cities, or to assume that death rates for negroes in general are equally valid for rural and for urban negroes, or to assume that death rates for 1910 are valid for the decades 1890-1900 and 1900-1910.

Death rates for 1900 by age groups, general nativity and color groups for registration cities, and for rural portions of registration states, are published in the 1900 census. (*124*). These death rates are by 10 year groups except for the ages 45 to 64, and 65 and over. This necessitates interpolation in the groups 45 years and over.

The 1900 death rates, with interpolations after the age of 45, would be exactly the material needed if it were not for chronological changes and if it were certain that the registration areas involved were typical of the corresponding areas in the country as a whole and in the several divisions. On the latter point, it should be noted that "cities of the registration area" included in 1900 all cities of over 8,000 population. The combined rates for such cities by age, nativity, and color groups differ more or less from the true rates for corresponding groups in cities of over 100,000 and in cities of 25,000 to 100,000. It has been assumed, however, that for the present purposes these differences are negligible. It should also be noted that the "rural" rates based on registration area data represent a much larger proportion of towns and villages of less than 8,000 than the rural area of the country as a whole, and on he other hand exclude cities of 8,000 to 25,000 which are included in the rural area in the age distribution figures used in the present study.

For correction of the chronological error only incomplete data are at hand. Death rates by ages for the registration area as a whole are quoted for 1890 in the 1900 census volume on vital

statistics. (*124*). The best procedure seems to be to assume that the desired rate for the 1890 to 1900 decade is the average between the 1890 and the 1900 rates, and to assume that all the white rates changed in the same ratio as the rates for corresponding ages in the registration area as a whole. For 1900 to 1910 it is possible to ascertain changes for urban whites, rural whites, and negroes separately, and it has been assumed that these changes, by ages, hold true for subdivisions of these groups. Among the negroes it appears that the death rate increased markedly between 1900 and 1910, while death rates for other groups showed consistent decreases in all except the older age groups. It seems probable, therefore, that the negro death rate was increasing rather than decreasing between 1890 and 1900, and this assumption has been made.

Some idea as to the validity of the above assumption of parallelism in the chronological changes in death rates for various groups may be gained from Table 2 which indicates that while the rural and urban death rates had the same general downward trend, the

TABLE 2

CHRONOLOGICAL CHANGES IN DEATH RATES

Percentages which the averages of the 1900 and 1910 death rates constituted of the 1900 rates, and which the 1900 rates constituted of the average of the 1900 and 1890 death rates, by ages, color, and residence groups. Based on data from *106* and *124*.

Ages	Registration Area, 1890-1900	Whites, registration cities 1900-1910	Whites, rural sections of registration states 1900-1910	Negroes, registration states 1900-1910
5-14	.87	.87	.84	.84
15-24	.94	.96	.88	1.06
25-34	.93	.89	.93	1.12
35-44	.94	.94	.99	1.13
45-54	.98			
55-64	1.02			
45-64		.96	1.03	1.10
65-74	1.06			
75-84	1.05			
85-94	1.10			
95-	1.09			
65-		.95	1.11	.98

rural rate decreased more rapidly in the early ages and actually increased in the later ages, while the urban rate showed a decrease in all age groups. The changes for the earlied decade seem to have been similar to those of the later one. The negro rates were in general increasing, especially in middle life.

In the application of the method for determining migration it is found to be more convenient to apply survival rates rather than death rates. The survival rate is unity minus the death rate; for example, if the death rate is one percent per year, the survival rate is 99 percent. A 10 year survival rate is the product of the 10 successive annual rates. The logarithm of the 10 year survival rate would therefore be the sum of the logarithms of the rates for the 10 individual years. In view of the proximate nature of the calculations for these minor corrections it was deemed sufficient to plot graphically the curve of the logarithms of the survival rates, and to approximate from the curve the logarithms of the 10 year survival rates. Parenthetically it should be observed that the intercensal period 1900 to 1910 was a month and a half less than 10 years, but no attempt was made to allow for this relatively insignificant factor. It would mean a decrease of a little over one percent in the number of deaths. The survival rates for different dates and groups, as calculated by the method above described are shown in Table 3. The rates designated "Glover—10 year groups" were derived by finding the sum of the males and females of the age, color, and residence specified, given in Glover's tables as population living at the specified ages, and using this total as a divisor with the corresponding total of the same description except for being 10 years older, as a dividend. This method involves a slight error due to the difference between the age distribution within the 10 year groups of actual populations and of the theoretical stationary populations assumed by Glover. As an experiment this distribution error was corrected in the age groups over 54 in the rural whites, and in one age group of urban whites, by weighting the 10 year survival rates for individual years of age as derived from Glover with the approximate age distribution by individual years of the actual populations involved. The results are designated in the table as "Glover—by single years."

Estimated Margin of Error

In appraising the results of the applications of the above

TABLE 3

ESTIMATED SURVIVAL RATES

Ten year survivals per 1000, as calculated with chronological corrections, from 1900 census data (*124*), and as derived directly from Glover's 1910 United States Life Tables (*106*, pp. 26-29, 38-45)

Ages at beginnings of decades	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84
Rural Whites								
Native-born								
Of native parents								
1895	955	939	929	911	861	708	458	221
1905	965	947	933	923	851	719	456	168
Of foreign parents								
1895	953	931	912	902	876	725	404	103
1905	964	942	923	904	865	725	408	150
Foreign-born								
1895	951	942	928	897	840	703	442	204
1905	964	951	934	901	830	690	440	163
Glover								
10-year groups	972	951	940	929	862	715	448	170
By single years	...	...	...	...	...	719	456	169
Urban Whites								
Native-born								
Of native parents								
1895	945	931	913	884	809	661	356	68
1905	953	940	926	890	822	689	436	122
Of foreign parents								
1895	945	912	872	853	800	644	355	84
1905	952	922	892	858	798	692	413	95
Foreign-born								
1895	950	928	895	846	750	596	353	86
1905	957	930	911	859	759	596	353	86
Glover								
10-year groups	970	949	918	876	785	614	384	157
By single years	...	...	...	...	790	...	...	...
Negroes								
Rural 1895	930	926	913	881	800	617	469	372
1905	936	912	892	851	777	612	482	374
Urban 1895	871	853	841	785	637	495	309	207
1905	878	830	805	743	635	471	369	262
Glover								
10-year groups	923	889	852	796	691	542	374	198

described method to the estimation of the extent of migration it is important to have some basis for determining the amount of error likely to be involved in the assumptions made. The reliability of the calculations is dependent upon the accuracy of the original census returns and of the reports as to deaths in the registration area, and upon the soundness of the following assumptions: that the death rates of the registration area, corrected for age, nativity, and urban-rural distribution, are representative of the death rates for the country as a whole; and that the chronological changes

correspond with those assumed on pages 17, and following. The factors involved are too complicated to permit the mathematical calculation of the probable errors, but in general the writer believes that is as likely as not that an average error of approximately five percent is involved in the estimates of migration. The error is probably greater in the decade in 1890-1900 than in the decade 1900-1910. It is probably greater in the estimates of migrations of native whites of native parentage and of negroes in rural districts than in other groups. The estimates of the migrations of the foreign-born are subject to smaller errors than those in the other groups. For no single nativity group as a whole, even in the earlier decade, is the probable error believed to be larger than 10 percent. As between the various age groups the percentage of error is likely to be smallest in the estimates for the ages at which the maximum migration occurred. These estimates for error do not cover the misreporting of nativities and race discussed on page 28. This misreporting affects the nativity distributions but not the totals for large cities, small cities or rural districts.

Estimation of Migration

The final step in the use of the method just described for measuring migration is the application of the survival rates to the various age groups, and the comparison of the number of survivors with the number of inhabitants of corresponding ages at the end of the decade. A sample of this process is presented in Table 4.

TABLE 4

Method of Estimating Migration

Estimation of migration by age groups of native white persons of native parentage into cities of the United States having in 1890 populations of over 100,000, during the decade 1890-1900. Based on data cited in previous tables, and in the text.

Ages in 1890	Population in 1890	Ten year survivals per 1000	Estimated number of survivors	Population in 1900	Migration
5-	2,374,713		2,077,252	2,383,689	306,437
5-14	597,621	945	564,752	744,314	179,562
15-24	533,934	931	497,093	634,584	137,491
25-34	475,494	913	434,126	427,900	—6,226
35-44	336,000	884	297,004	286,079	—10,925
45-54	215,442	809	174,293	173,114	—1,179
55-64	129,002	661	85,270	87,890	2,620
65-74	65,220	356	23,218	29,808	5,094
75-	22,000	68	1,496		

Persons under five years of age at the beginning of the decade are, in Table 4, as in preceding tables, omitted from the calculations. The reasons for this are three-fold: first, that the census returns of children under five years show irregularities in age distribution which may possibly indicate that the returns are less complete at these ages than in later years; second, that the death rates have such extreme variation during this period as to make difficult the accurate calculation of survival rates; and third, that it is questionable whether children migrating with their parents should not be considered as part of the natural increase rather than as part of the migration. It seems probable that further study of this age group may develop accurate methods of estimating migration of persons within it. For the foreign-born the very small number of children under five years of age eliminates the difficulty.

8. MIGRATION IN THE UNITED STATES. 1890-1910.

General Summary

The results of these calculations for the United States as a whole, (exclusive of outlying possessions) are summarized in Table 5. The results are stated in thousands because it is believed that the methods do not justify a pretense to accuracy beyond that point. Most of the calculations have been performed on a 10 inch slide rule, and hence accuracy cannot be claimed beyond the first three or four digits.

Check Against Census Data on Foreign Immigration

Before discussing the interpretation of the results summarized in Table 5 it is worth while to check its conclusions against certain independent data with which comparison is possible. The net addition to the population of the United States through immigration of foreign whites is stated in the table as 2,653,000 in the first decade, and 4,957,000 in the second decade. The census returns of foreign-born whites residing in the United States on the date of the 1910 census who immigrated during the year 1901 to 1910 indicate 5,000,028 such persons (including a proportionate number of those for whom the year of immigration was not reported.) (*125* p. 1017) With an allowance for the immigration during the months of 1900 succeeding the census of that year, the corrected number becomes approximately 5,160,000. This number, however, does not represent the net gain in population

TABLE 5

Summary of United States Migration 1890-1910

Migration into and out of (-) the United States, and between large, cities, small cities, and rural territory, stated in thousands, for the decades 1890-1900 and 1900-1910, as estimated by the age distribution method from data referred to in previous tables, and in the text.

Nativity group	Ages at beginnings of decades	1890-1900				1900-1910			
		United States as a whole	Rural and cities under 25,000 in 1890	Cities 25,000-100,000 in 1890	Cities over 100,000 in 1890	United States as a whole	Rural and cities under 25,000 in 1900	Cities* 25,000-100,000 in 1900	Cities* over 100,000 in 1900
All nativities	Five years and over	1,300	—1,070	675	1,695	3,679	—376	1,469	2,586
Foreign-born white	All ages	2,653	1,093	347	1,213	4,957	2,026	718	2,213
	-4	377	178	43	156	607	241	76	290
	5-14	869	356	116	397	1,666	656	235	775
	15-24	927	382	119	426	1,778	748	240	790
	25-34	308	103	43	162	618	281	88	249
	35-44	135	90	13	32	184	75	41	68
	45-54	—14	—40	6	20	12	—8	12	8
	55-64	32	20	3	9	54	17	15	22
	65-	19	4	4	11	38	16	11	11
Native white and negroes	Five and over	—976	—1,985	371	638	—671	—2,161	827	663
	5-14	90	—776	207	359	204	—578	379	403
	15-24	—782	—1,115	106	227	—577	—1,109	241	291
	25-34	—98	—188	29	61	—69	—155	88	—2
	35-44	—32	—11	5	—26	—33	—77	59	—15
	45-54	—201	—213	10	2	—217	—220	28	—25
	55-64	17	1	7	9	2	—21	20	3
	65-	30	17	7	6	19	—1	12	8

TABLE 5 (continued)

Nativity group	Ages at beginning of decades	1890-1900				1900-1910			
		United States as a whole	Rural and cities under 25,000 in 1890	Cities 25,000-100,000 in 1890	Cities over 100,000 in 1890	United States as a whole	Rural and cities under 25,000 in 1900	Cities* 25,000-100,000 in 1900	Cities* over 100,000 in 1900
Native white of native parentage	Five and and over	—893	—1,408	208	307	106	—986	593	499
	5-14	6	—294	121	179	298	—228	259	267
	15-24	—481	—690	71	138	—146	—547	178	223
	25-34	—171	—163	—2	—6	32	—45	63	14
	35-44	—89	—80	2	—11	—8	—48	42	—2
	45-54	—166	—172	7	—1	—107	—122	26	—11
	55-64	—11	—18	4	3	3	—14	15	2
	65-	19	9	5	5	34	18	10	6
Native white of foreign or mixed parentage	Five and and over	218	—69	95	192	—422	—500	87	—9
	5-14	105	—59	46	118	—47	—168	56	65
	15-24	—89	—139	13	37	—221	—220	10	—11
	25-34	106	23	31	52	—83	—50	7	—40
	35-44	52	75	—2	—21	—38	—33	9	—14
	45-54	15	9	4	2	—40	—32	2	—10
	55-64	16	10	2	4	—1	—2	2	—1
	65-	13	12	1	0	8	5	1	2
Negroes	Five and and over	—301	—508	68	139	—355	—675	147	173
	5-14	—21	—123	40	62	—47	—182	64	71
	15-24	—212	—286	22	52	—210	—342	53	79
	25-34	—33	—48	0	15	—18	—60	18	24
	35-44	5	—6	5	6	13	4	8	1
	45-54	—50	—50	—1	1	—70	—66	0	—4
	55-64	12	9	1	2	0	—5	3	2
	65-	—2	—4	1	1	—23	—24	1	0

* St. Joseph, Missouri, is included among the cities of 25,000 to 100,000, not among the cities of over 100,000.

due to foreign white migration during the decade, for it makes no allowance for the foreign-born whites who were resident in the United States in 1900 but who left during the decade and had not returned at the date of the 1910 census. There seems to be no reliable direct way of estimating how great the number of such persons may have been, but it is not at all incredible that it amounted to very nearly the difference between the estimate of net foreign-born white migration as given in Table 5, and the corrected census returns of foreign-born white persons living in the United States in 1910 who immigrated during the decade between the censuses, which difference was 203,000.

For the preceding decade the number of foreign-born whites living in the United States at the census of 1900 who immigrated during the preceding decade was about 2,775,000 according to census returns. (*125* p. 1017) This corresponds, with relatively about the same margin as in the second decade, to the estimate of 2,653,000 derived by the age-distribution method, as given in Table 5.

A less exact check is available with regard to the estimates of native emigration. The Canadian government returns the number of migrants from the United States to Canada during the years 1897-1913 as 923,148. (*108*) This would indicate an emigration to Canada during the decade 1900-1910 of about 540,000. The net emigration of native whites and negroes from the United States during the decade 1900-1910 as estimated by the age distribution method was 671,000. The reporting of foreign-born persons as natives (see page 28) probably means that the true number is much larger than this. The Canadian returns presumably are gross without allowance for natives of the United States returning to this country. The age distribution method, moreover, excludes emigrants who died before the 1910 census.

Migration and Natural Increase as Factors in Rural and Urban Growth

The highly concentrated character of Table 5 makes it desirable to abstract certain of its important aspects for detailed study. The significance of the general totals of migration, designated as ''all nativities'' in Table 5 is made clearer in Table 6 by showing what percentage these migrations constituted of the average populations involved, and how important the migrations

were as compared with natural increase, including as natural increase all sources of increase other than migration of persons over five years old at the beginning of the decades.

Table 6 indicates the following facts. During the decade 1890

TABLE 6

SOURCES OF URBAN AND RURAL POPULATION GROWTH

Increases in population in urban and rural districts, separated into migration of persons five years of age or over at the beginnings of the decades, and natural increases, showing the percentages which the gains constituted of the average populations of the respective areas. 1890-1910. Absolute numbers stated in thousands. Based on Table 5 and its supporting data.

	United States as a whole		Rural territory and small cities		Cities of 25,000 to 100,000 at beginnings of decades		Cities of over 100,000 at beginnings of decades	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1890-1900								
Average population	69,116	100.0	52,841	100.0	4,959	100.0	11,316	100.0
Net increase	13,054	18.9	8,470	16.0	1,284	25.9	3,300	29.1
Migration	1,300	1.9	—1,070	—2.0	675	13.6	1,695	14.9
Natural increase	11,754	17.0	9,540	18.0	609	12.3	1,605	14.2
1900-1910								
Average population	83,606	100.0	60,577	100.0	6,789	100.0	16,240	100.0
Net increase	15,912	19.0	9,268	15.3	2,320	34.2	4,324	26.6
Migration	3,679	4.4	—376	—.6	1,469	21.6	2,586	15.9
Natural increase	12,233	14.6	9,644	15.9	851	12.5	1,738	10.7

to 1900 the population of the United States increased about 19 percent of the average during the decade. Of this increase, 17.0 percent was due to natural increase (as defined above) and only 1.9 percent was due to the excess of immigration over emigration. During the decade 1900 to 1910 the total percentage increase was practically the same as 10 years previous, but natural increase amounted to only 14.6 percent of the average population, while net migration added 4.4 percent. Rural districts and small urban centers increased less rapidly than the larger cities, but this was due to net losses through emigration which offset part of the large natural increase. In 1890 to 1900 the rural districts had a natural increase half again as large as that of the medium sized cities, and over one-fourth larger than that of the large cities. The cities secured more than half of their growth from net migration, and less than half from natural increase, even interpreting natural increase in the broad sense used herein.

The urban and rural districts show striking changes in the

second decade. Natural increase fell off sharply in the rural districts and in the cities over 100,000, but remained about stationary in the medium sized cities. The percentage loss to rural districts and small cities from net migration *decreased* to less than one percent. Net migration gains in medium sized cities shot up from 13.6 to 21.6 percent, giving this group a considerable lead over the large cities in rate of population increase. Large cities during this decade had a larger increase from migration than 10 years previously, but this was offset by the great drop in natural increase.

In considering migratory losses and gains it is important, of course, to distinguish foreign-born from native-born migration. A summary on this point is presented in Table 7.

TABLE 7

FOREIGN IMMIGRATION AND NATIVE MIGRATION

Migratory gains and losses (–) in thousands in urban and rural districts of the United States, according to general nativities of the migrants, 1890-1910. Data derived from Table 5.

	1890-1900				1900-1910			
Nativity	United States	Rural	Med'm cities	Large cities	United States	Rural	Medi'm cities	Large cities
Both groups	1,300	—1,070	675	1,695	3,679	—376	1,469	2,586
Foreign white*	2,276	915	304	1,057	4,350	1,785	642	1,923
Native white and negro	—976	—1,985	371	638	—671	—2,161	827	663

* For the sake of comparability between the two groups, migration of foreign whites in this table excludes those immigrants who were less than five years old at the beginnings of the decades.

Foreign white immigration increased between the two decades, according to this table, by over two million. Emigration of natives from the United States, on the other hand, decreased about 300,000.

Rural districts and small cities gained, during the first decade, over 900,000 foreign immigrants, and lost nearly 2,000,000 native emigrants. In the second decade the amount of foreign immigration to rural districts and small cities was nearly doubled, reaching about 1,800,000. Migration of natives from rural districts increased however, only about 10 per cent in the 10 years. In medium sized cities, gains from native migration were greater in both decades than gains from foreign immigration. Gains from each of the two sources more than doubled between the decades. Large cities, however, got only a little over a third of their net

immigration from natives of the United States in the first decade, and less than one-fourth in the second decade. It should be noted that, of the natives who migrated from the rural districts in the first decade, over half emigrated from the United States, while of those in the second decade only about one-sixth emigrated.

The above conclusions with regard to the relative importance of foreign immigration and rural migration in building up the cities may be compared roughly with the conclusions of Clark, (*134*), and Gillette, (*138*), arrived at by use of the total-increase-minus-natural-increase method. Eliminating Gillette's allowance for incorporation, (a factor which the other studies take account of by other methods) the percentages of the total urban increase assigned by the two previous studies and by the present study to natural increase, foreign immigration, and rural migration, are as tabulated in Table 8.

TABLE 8

VARIOUS FINDINGS AS TO SOURCES OF CITY GROWTH

Percentages which natural increase, foreign immigration, and rural migration constituted of urban increase (exclusive of gains through "incorporation") from 1900 to 1910 according to Gillette (*139*) Clark (*134*) and the present writer (Table 5)

Sources of increase	Gillette: incorporated places over 2,500	Clark: incorporated places over 2,500	The present writer: Cities of 25,000 to 100,000	The present writer: Cities of over 100,000
Natural increase	22.3	27.3	33.4	33.5
Foreign immigration	44.4	30.0 to 37.1	30.9	51.2
Under four years, 1900			3.2	6.7
Over four in 1900			27.7	44.5
Rural migration	33.3	42.7 to 35.6	35.7	15.3
Total increase	100.0	100.0	100.0	100.0

The data in this table are, of course, not exactly comparable. Natural increase, according to Clark, is the excess of all births over all deaths. According to Gillette's method, natural increase comprises only the excess of births over deaths in the original population. In the writer's estimates as given in earlier tables natural increase has included some children born before they migrated. In order to minimize this factor of difference in Table 8, the immigrating children of foreign immigrants have been included as migrants. No estimate of the number of young chil-

dren of native migrants has been made, but in view of the fact that over 90 percent of the native migrants to cities were five to 24 years of age at the beginning of the decade, as compared with 80 percent of the foreign immigrants, and in view of the greater fecundity of the foreign-born, it seems certain that native migrants to cities comprised relatively a smaller proportion of children than foreign immigrants. Part of the discrepancy in the estimates of rural migration is due to the fact that the other investigations include places of 2,500 to 25,000 which are omitted in the present writer's estimates, and that small cities have more rural migration relatively than large. Such cities however constitute much less than one-third of the total urban territory. The conclusion seems clear in any case, that in cities of over 100,000 in the decades considered rural migration played a comparatively minor rôle as a factor in urban growth, and that it was relatively less important in the second decade than in the first. In the middle-sized cities, migration from rural districts was responsible for approximately one-third of the urban increase.

Reporting of Colored Persons as White and of Foreign-Born as Native-Born

The next step, logically, in the interpretation of the data in Table 5, would be to analyze the native migration according to paternity and color. Certain striking facts stand out in such an analysis. During the first decade native whites of native parents showed a net loss through emigration of nearly 900,000, while during the second decade, this group showed a gain through migration of over 100,000. Among native whites of foreign or mixed parentage this condition is reversed: this group showed a gain of about 220,000, through migration in the first decade, and an emigration of 420,000 in the second. The apparent conclusion is that native emigrants from the United States were chiefly of native stock in the earlier decade, and chiefly of foreign stock in the second. This conclusion is doubtless valid.

A certain inconsistency, however, appears in the figures as to nativities and color. How can it be that native whites immigrate into the United States? In order to do so they must have left the country previously. Possibly they might be returning emigrants. The age distribution, however, does not favor this hypothesis. A natural suggestion is that the apparent anomaly is

TABLE 9

PROOF OF INCORRECT COLOR OR NATIVITY REPORTS

"Native white" population of native parents in the United States in certain age groups in 1900 compared with "native white" population of nativ parents ten years older in 1910. (*125* pp. 336-7)

Ages		Population	Population	Increase or
In 1900	In 1910	1900	1910	decrease (—)
-4	10-14	5,464,881	5,324,283	—140,598
5-9	15-19	5,174,220	5,089,055	—85,165
10-14	20-24	4,660,390	4,682,922	22,532
15-19	25-39	4,234,953	4,049,074	—185,879
20-24	30-34	3,805,609	3,401,601	—404,008

due to an error in calculations, but it can readily be shown that it is not. Table 9 presents data on this point.

In 1910, it will be observed, there were 22,532 more native whites of native parentage 20-24 years of age than there were 10 years previous native white of native parentage 10-14 years of age. Moreover, at least three percent of the original group in 1900 must have died during the 10 years, even taking the lowest death rate which could conceivably apply. This means that about 140,000 native whites of native parents in addition to the 22,532, appeared from some source during the decade. For the preceding age group not less than two percent died during the decade, or 103,500. This leaves over 18,000 native white ''immigrants'' of native parentage in this age group. If four percent of the youngest age group died during the decade, and if the returns in this group are complete, about 78,000 native white ''immigrants'' of native parentage in this group must be accounted for. In the age groups 15-24 in 1900 the decreases in population are greater than can be accounted for by the low death rates conceded in the discussion of Table 9.

If then the apparent immigration of native whites of native parents at certain ages cannot be reasonably accounted for as the return to the United States of previous emigrants, and if it is not the result of incorrect calculations, the conclusion seems inevitable that something is wrong with the census returns. The estimates of negro immigration given in Table 5 throw light upon the problem. It is estimated there that 301,000 negroes emigrated from the United States in the first decade, and 355,000 in the second. In view of the small numbers of negroes in the most northerly cities of the United States at the dates under consideration it seems unlikely that any such volume of emigration went to Canada.

Neither is it plausible to suppose that it went to Mexico. Certain numbers of negroes doubtless emigrated to Cuba, Porto Rico, Africa, and other places, but it is questionable whether the numper exceeded the number of negro immigrants, of whom about 32,000 entered during the decade. (*128*). If then there is apparently a fictitious immigration of whites, and a fictitious emigration of negroes, it seems plausible to suppose that ''migration'' on the part of negroes into the white race has occurred. Mulattoes are enumerated as negroes, and it is obvious that with the mixing of the races which has gone on and is going on, practically white individuals are constantly being born into mulatto families. Many of these individuals when they reach an age to separate themselves from their parents, presumably migrate to a new locality, and report themselves as white.

That this process has actually been going on is freely acknowledged by students of the negro problem. Ray Stannard Baker in ''Following the Color Line'' (*130*) discusses illustrative cases where mulattoes have ''gone over to white.'' A. M. Moore, a negro writing in a recent number of the Survey, (*146*) says: ''This all means that as negroes become lighter in complexion they cross the color line and become amalgamated and lost in the white race.'' The present calculations, therefore, simply make possible an estimate of the extent to which migration from the negro to the white race has been occurring. Since there has, apparently, been very little if any net emigration of negroes from the United States, it seems probable from the estimates summarized in Table 5 that a quarter of a million or more persons per decade born in families classified as negro report themselves as members of the white race.

This reporting of themselves as white by persons born in negro families is not sufficient, however, to account for the apparent immigration of native-born persons into the United States. Taking native whites and negroes together there were in the first decade 90,000 ''immigrant'' native Americans who were 5-14 years old in 1890, and in the second decade 204,000. It is perhaps significant that in the earlier decade the native whites of foreign or mixed parentage showed a net ''immigration'' of 218,000. The only theory which seems to account satisfactorily for these returns is that foreign-born persons are reporting themselves in large numbers as native-born. The full extent to which this has occurred

is not apparent in the estimated excess of native Americans, for the emigration of natives from the United States tends to cover up the phenomenon of informal naturalization or nativization by the foreign-born. It seems difficult to escape the conclusion, that over 250,000 foreigners reported themselves as natives in 1910. This is entirely consistent with the data on immigration, since over 8,000,000 immigrants entered the United States in the decade, and only a little over 5,000,000 foreigners in 1910 admitted having immigrated during the preceding 10 years. It has been assumed that the difference was due to deaths and to returns to foreign countries by the foreign-born. Migration into the "native white" group by a few hundred thousand foreign-born simply means that the return emigration or the death rates were a little smaller than has been supposed. Of course this assumption involves the further conclusion that an additional number of native Americans have emigrated to foreign countries, since the total increase in the population is known, and the additional contribution to the population through immigration assumed under this theory must have been offset in some way.

The conclusion that negroes and foreign whites are reporting themselves in large numbers as native whites, tends to cast grave doubts upon the reliability of nativity and color classifications of the census returns. If false reporting is going on to the extent indicated by these estimates it is certainly unsafe to accept at their face value the census returns on these points. Yet it seems entirely plausible to assume that such falsification has occurred. The social, political, and economic disadvantages incurred by being a negro or by being a foreigner are a tremendous handicap to an individual. No elaborate investigations are made to verify an individual's assertion that he is a native white American. With the immense amount of migration that is occurring in the United States it is not difficult to throw off past associations sufficiently to make a new start in life, particularly at the ages of 15 to 24 when family ties are broken, and new economic relationships established.

Age Distribution of Migrants

The ages at which migration occurred is the next point for analysis in connection with Table 5. The method used gives, not the age at migration, but the age grouping of migrants at the

census dates preceding and succeeding the migration. These age distributions, reduced to percentages for the sake of comparison, are summarized in Table 10.

The age distribution of foreign white immigrants appears not to have changed very decidedly between the decades, and seems to be remarkably similar in urban and rural territory. The most

TABLE 10

PERCENTAGE AGE DISTRIBUTION OF MIGRANTS

Percentages which migrants of each age group constituted of all migrants five years of age and over at the beginnings of the decades, for the several migrating classes. Based on Table 5.

Classes of Migrants	Ages at beginnings of decades -4	5-14	15-24	25-34	35-44	45-54	55-64	65-	5-
Foreign White									
To the U. S.									
1890-1900	(16.6)	38.2	40.7	13.6	5.9	—.6	1.4	.8	100.0
1900-1910	(14.0)	38.3	40.9	14.2	4.2	.3	1.2	.9	100.0
To rural areas									
1890-1900	(19.4)	38.9	41.8	11.3	9.8	—4.4	2.2	.4	100.0
1900-1910	(13.5)	36.8	41.9	15.7	4.2	—.5	1.0	.9	100.0
To medium cities									
1890-1900	(14.1)	38.2	39.1	14.1	4.3	2.0	1.0	1.3	100.0
1900-1910	(11.8)	36.6	37.4	13.7	6.4	1.9	2.3	1.7	100.0
To large cities									
1890-1900	(14.7)	37.5	40.3	15.3	3.1	1.9	.9	1.0	100.0
1900-1910	(15.1)	40.3	41.1	13.0	3.5	.4	1.1	.6	100.0
Native White and Negro									
From the U.S.									
1890-1900		9.2	—80.1	—10.0	—3.3	—20.6	1.7	3.1	100.0
1900-1910		30.6	—86.5	—10.0	—4.8	—32.4	.3	2.8	100.0
From rural areas									
1890-1900		—24.0	—56.2	—9.5	—.6	—10.7	.1	.9	100.0
1900-1910		—26.8	—51.4	—7.1	—3.5	—10.2	—1.0	.0	100.0
To medium cities									
1890-1900		55.8	28.6	7.8	1.3	2.7	1.9	1.9	100.0
1900-1910		45.8	29.2	10.6	7.1	3.4	2.4	1.5	100.0
To large cities									
1890-1900		56.3	35.6	9.6	—4.1	.3	1.4	.9	100.0
1900-1910		60.8	43.9	—.3	—2.3	—3.8	.5	1.2	100.0

striking changes and contrasts which did occur were among the immigrants less than five years of age at the beginnnig of the decades. The number of such immigrants, relative to the number at older ages, was markedly greater in rural than in urban districts in the first decade. In the second decade this condition was sharply reversed by a decrease of nearly a third in the proportion of rural immigrants of the youngest age group, and a slight increase in the proportion in large cities. Similar tendencies appeared in the age group five to 14. The medium sized cities changed in the same direction as the rural districts, but to a less degree. Aside from this alteration of the proportion of young immigrants, the age distribution was fairly constant and uniform for the foreign-born. From 74 to 82 percent of all foreign-born immigrants over four years old at the beginnings of the decades were five to 24 years of age at those dates.

A fairly accurate idea of the ages at migration may be obtained from the age distribution at census dates. If the percentage of migration per year of age were constant throughout the age groups 75 per cent of the migrants of a given decade x to x + 9 years of age inclusive at the beginning of a decade would migrate at the ages x+5 to x+14 years inclusive. The other 25 percent would overlap adjacent groups. If the distribution throughout the age groups were constant these overlappings would balance each other. Under actual conditions they do not balance exactly, but the differences are small enough to be ignored for practical purposes. It is sufficiently exact to assume that migrants of a given decade five to 14 years of age at the beginning of the decade migrated for the most part at the ages of 10-19, that those 15-24 at the beginning of the decade, migrated at the ages of 20-29 and so forth.

On this basis it appears that over three quarters of the foreign immigrants over 10 years of age enter the United States at the ages 10-29, and that this proportion is fairly constant for the two decades and for urban and rural communities. Native white and negro migrants from the rural areas, are even more concentrated in their age distribution. More than half of them migrate at the ages 20-29, and an additional fourth at the ages 10-19 (which probably means chiefly 15-19).

Migration to cities occurs at earlier ages than immigration or emigration for the United States as a whole. Over half of the net

migration to cities occurs at the ages 10-19. In medium sized cities this percentage decreased from about 55 to about 45 percent between the decades. In large cities, however, it increased from about 55 to about 60 percent. The large cities show a fairly marked emigration of natives in the age periods after 30. So pronounced is the concentration of the cityward migrants in the age group just preceding 20, that it is fairly accurate to say that such migration is a phenomenon of the adolescent period.

The results of Table 5 and the points which have been brought out in the discussion on the preceding pages may well be summarized graphically. Charts 2, 3, and 4, have been constructed for this purpose. Each shows side by side migration for the two decades distributed according to age periods. In each one the enclosed area above the base line indicates the amount of net immigration, while the enclosed area below the base line indicates the amount of net emigration. The feathered edges in the earlier

CHART 2

UNITED STATES MIGRATION BY AGES

Foreign-born white immigration to the United States and native emigration from the United States, 1890-1910, distributed according to ages. Source of data Table 5.

Number of migrants per 10 year age group.

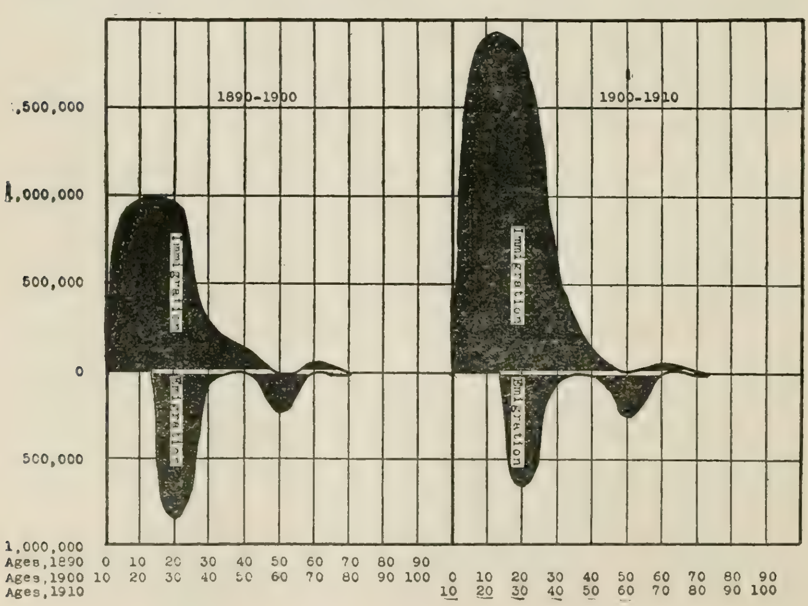


CHART 3

RURAL MIGRATION BY AGES

Net native emigration from rural districts (including cities of less than 25,000) and net foreign-born immigration to such districts of the United States, by age periods, 1890-1910. Source of data Table 5.

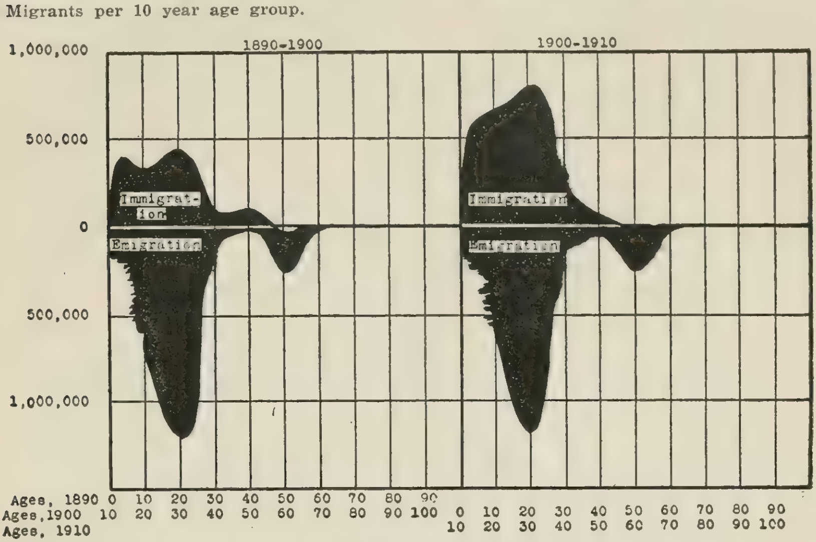
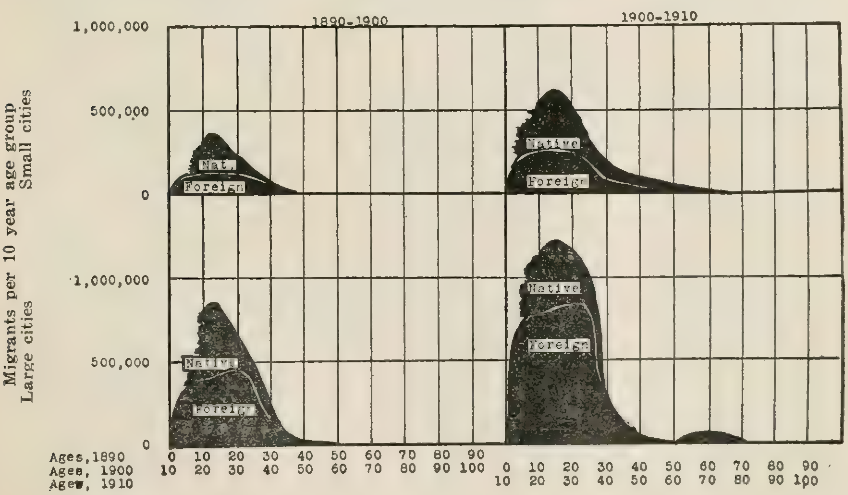


CHART 4

URBAN MIGRATION BY AGES

Net migration to cities of 25,000-100,000 and to cities of over 100,000 in the United States, by general nativities, distributed according to ages. Source of data Table 5.



age periods call attention to the fact that no estimates were made of the amount of native migration at ages under 10 years.

Migration by Divisions

The United States is much too large a unit to constitute the final basis for the measurement of migration. It is important to know the directions in which the currents of population are flowing within the country, and their volumes and rates of speed. For this purpose an analysis of migration has been made by divisions. It

TABLE 11

Migration by Divisions, in Thousands

as estimated by the age distribution method. Sources of data: *124*; *125*, p. 432.

Residence, nativity and age groups	Divisions and Decades							
	All divisions		New England		Middle Atlantic		East North Central	
	1890-1900	1900-1910	1890-'00	1900-'10	1890-'00	1900-'10	1890-'00	1900-'10
All migrants	1296	3688	394	437	898	1737	350	384
Five to 14	963	1883	229	259	456	829	173	242
15-	333	1805	165	178	442	908	177	142
Rural, all natvts.	—1073	—369	98	129	—82	391	—274	—511
Five to 14	—121	94	85	86	21	172	—62	—131
15-	—952	—463	13	43	—103	219	—212	—380
Nat. wh. nat. par.	—1405	—984	—64	—43	—270	—156	—393	—492
Five to 14	—296	—220	—1	—2	—67	—44	—89	—143
15-	—1109	—764	—63	—41	—203	—112	—304	—349
Nat. wh. for. par.	—68	—500	—4	—30	—56	—57	—58	—294
Five to 14	—59	—165	1	—10	—22	—15	—36	—92
15-	—9	—335	—5	—20	—34	—42	—22	—202
Foreign white	907	1786	164	202	227	595	172	280
Five to 14	356	657	83	108	96	222	62	104
15-	551	1129	81	105	131	373	110	176
Negro	—508	—671	2	0	17	9	5	—5
Five to 14	—122	—178	2	1	14	9	1	0
15-	—386	—493	0	—1	3	0	4	—5
Urban, all natvts.	2369	4057	296	308	980	1346	624	895
Five to 14	1084	1789	144	173	435	657	235	373
15-	1285	2268	152	135	545	689	389	522
Nat. wh. nat. par.	515	1086	42	25	170	134	160	254
Five to 14	300	523	22	20	94	94	78	127
15-	215	563	20	5	76	40	82	127
Nat. wh. for. par.	286	87	17	—34	64	—88	116	28
Five to 14	166	125	16	2	50	6	52	28
15-	120	—38	1	—36	14	—94	64	0
Foreign white	1362	2557	230	309	686	1226	314	567
Five to 14	515	1004	103	148	265	529	93	203
15-	847	1553	127	161	421	697	221	364
Negro	206	327	7	8	60	74	34	46
Five to 14	103	137	3	3	26	28	12	15
15-	103	190	4	5	34	46	22	31

would be possible in making such estimates to follow out for each division the method used for the United States as a whole. It was deemed advisable, however, to utilize a short-cut method which is probably accurate enough for the present purposes. This method involves the assumption that the survival rates in the various divisions, when corrected for age, general nativity, color, and urban-rural distribution, were identical. The groups five to 14 years of age at the beginning of the decades were kept separate. Later age groups were lumped, and weighted average survival rates applied to them. The results are summarized in Table 11.

The first line of Table 11 designated "All Migrants" summarizes the net effects of migration (excluding migrants under five at the

Table 11, Continued

Residence, nativity, and age groups	Divisions and Decades					
	West North Central		South Atlantic		East South Central	
	1890 -'00	1900 -'10	1890 -'00	1900 -'10	1890 -'00	1900 -'10
All migrants	—213	—143	—400	—301	—367	—545
Five to 14	—7	47	—76	—12	—75	—129
15-	—206	—190	—324	—289	—292	—416
Rural, all	—323	—454	—500	—477	—431	—702
Five to 14	—90	—104	—140	—114	—113	—201
15-	—233	—350	—360	—363	—318	—501
Native white native parents	—416	—412	—218	—221	—290	—422
Five to 14	—113	—113	—55	—48	—83	—121
15-	—303	—299	—163	—173	—207	—301
Native white foreign parents	—40	—207	5	6	—3	—19
Five to 14	—25	—65	1	2	—1	—6
15-	—15	—142	4	4	—2	—13
Foreign white	153	183	18	66	3	6
Five to 14	53	79	6	21	2	3
15-	100	104	12	45	1	3
Negro	—20	—18	—305	—328	—142	—269
Five to 14	—5	—5	—92	—89	—31	—77
15-	—15	—13	—213	—239	—110	—190
Urban, all	110	311	100	176	64	157
Five to 14	83	151	64	102	38	72
15-	27	160	36	74	26	85
Native white native parents	21	112	37	72	14	89
Five to 14	31	67	25	46	15	41
15-	—10	45	12	26	—1	48
Native white foreign parents	37	36	2	—5	11	—2
Five to 14	22	28	3	1	4	2
15-	15	8	—1	—6	7	—4
Foreign white	37	139	24	43	6	11
Five to 14	22	48	9	17	2	3
15-	15	91	15	26	4	8
Negro	15	24	37	66	33	59
Five to 14	8	8	27	38	17	26
15-	7	16	10	28	16	33

beginnings of the decades) for the several divisions. As noted previously in connection with Table 5, the net gain for the country as a whole from this source was nearly three times as great in the second as in the first decade. The division receiving the largest gain from this source was the Middle Atlantic, comprising New York, Pennsylvania, and New Jersey. These three states had a gain in the first decade from this source more than two-thirds as large as the net gain for the United States as a whole. In the second decade this division had a net gain somewhat under half as large as the net gain for the nation as a whole. Three divisions—the West North Central, the South Atlantic, and the East South Central (the last two comprising approximately the "solid south"

Table 11, Continued

	Divisions and Decades					
	West South Central		Mountain		Pacific	
	1890-'00	1900-'10	1890-'00	1900-'10	1890-'00	1900-'10
All migrants	227	398	168	494	239	1227
Five to 14	105	156	74	161	84	330
15-	122	242	94	333	155	897
Rural, all	179	231	152	413	108	611
Five to 14	80	87	63	137	35	162
15-	99	144	89	276	73	449
Native white native parentage	158	235	57	228	31	299
Five to 14	70	91	29	75	13	85
15-	88	144	28	153	18	214
Native white foreign parentage	32	—8	34	32	22	77
Five to 14	8	—7	10	8	5	20
15-	24	—1	24	24	17	57
Foreign white	55	70	61	152	54	232
Five to 14	17	22	21	53	16	56
15-	38	48	40	99	38	176
Negro	—66	—66	0	1	1	3
Five to 14	—15	—19	3	1	1	1
15-	—51	—47	—3	0	0	2
Urban, all	48	167	16	81	131	616
Five to 14	25	69	11	24	49	168
15-	23	98	5	57	82	448
Native white native parentage	13	84	2	40	56	276
Five to 14	9	34	4	14	22	80
15-	4	50	—2	26	34	196
Native white foreign parentage	5	14	5	21	29	117
Five to 14	3	8	2	8	14	42
15-	2	6	3	13	15	75
Foreign white	9	32	8	17	48	213
Five to 14	3	11	5	1	13	44
15-	6	21	3	16	35	169
Negro	21	37	1	3	—2	10
Five to 14	10	16	0	1	0	2
15-	11	21	1	2	—2	8

and the first including Iowa and neighboring states) sustained net losses through migration in both decades. The greatest increase in the gains through migration was in the Pacific division which jumped from a net gain of 239,000 (exclusive of Asiatic immigration) in the first decade to a gain of 1,227,000 in the second decade, a gain more than two-thirds as great as that of the Middle Atlantic states.

The Rural Exodus

Rural losses through migration, (meaning by "rural" all territory outside cities over 25,000) occurred in both decades in the East North Central, West North Central, South Atlantic, and East South Central States, and during the first decade in the Middle Atlantic States. Rural Gains in the New England States in both decades, and in the Middle Atlantic States in the second decade were due to foreign immigration. The three western divisions which gained in rural population through migration received chiefly native whites, though foreign-born whites were taking a place of increasing importance.

Since rural emigration is of such central importance in the present study, Table 12 has been prepared by assembling all of the

TABLE 12

Sources of the Rural Exodus

Emigration in thousands from territory outside cities over 25,000, by divisions and nativities, 1890-1910. Derived from Table 11.

Divisions	1890-1900				1900-1910			
	All nativities	Native White		Negro	All nativities	Native White		Negro
		Native Par.	For'n Par.			Native Par.	For'n Par.	
United States	—2,345	—1,651	—161	—533	—3,045	—1,746	—615	—684
New England	—68	—64	—4	...	—73	—43	—30	...
Middle Atlantic	—326	—270	—56	...	—213	—156	—57	...
East North Central	—451	—393	—58	...	—791	—492	—294	—5
West North Central	—476	—416	—40	—20	—637	—412	—207	—18
South Atlantic	—523	—218	...	—305	—549	—221	...	—328
East South Central	—435	—290	—3	—142	—708	—422	—19	—267
West South Central	—66	.....	...	—66	—74	.....	—8	—66
Mountain	.....	.....	...	...	.....	.....	...	...
Pacific	.....	.....	...	...	.....	.....	...	...

net losses in rural districts. This does not show the entire rural losses, for migration from strictly rural districts to cities under 25,000 is not indicated. Immigration of the foreign-born has been ignored in this table, and net rural gains in native-born through migration are not shown. The purpose of the table is to present as fully as possible the extent and the sources of the exodus of the native-born from the rural districts of the various divisions.

The extent of the exodus, as thus presented, was over two and a third millions in the first decade, and over three millions in the second decade. The divisions with important rural losses in the first decade were, in the order of the size of their losses: South Atlantic, West North Central, East North Central, East South Central, Middle Atlantic. In the second decade the Middle Atlantic States showed a decidedly lower rural emigration than in the first decade, while the east North Central, West North Central, and East South Central divisions lost much larger numbers than in the previous decade. These three divisions, comprising the great Mississippi basin, sustained a net rural emigration of 2,131,000 native-born persons during the decade of 1900-1910. Emigration of second-generation immigrants began to be a serious factor in the problem in the second decade. Negro emigration from rural territory, which amounted to over half a million in the first decade increased to 684,000 in the second.

TABLE 13

Destinations of the Rural Exodus

Immigration of native whites and negroes, in thousands, by divisions, 1890-1910. Derived from Table 11.

Divisions	1890-1900			1900-1910		
	Total	Cities over 25,000	Other areas	Total	Cities over 25,000	Other areas
Net Rural Exodus	2,345			3,045		
To Foreign Countries	962			526		
To the United States	1,383	1,019	364	2,519	1,623	890
New England	68	66	2	33	33	...
Middle Atlantic	311	294	17	217	208	9
East North Central	315	310	5	328	328	...
West North Central	73	73	...	172	172	...
South Atlantic	81	76	5	144	138	6
East South Central	68	68	...	148	148	...
West South Central	229	39	190	370	135	235
Mountain	99	8	91	325	64	261
Pacific	139	85	54	782	403	379

The destination of rural emigration is indicated by Table 13. In the first decade less than half, and in the second decade a little over half of the rural emigration can be accounted for by native migration to cities over 25,000 in the United States. In the first decade nearly a million of our rural emigrants left the United States while 364,000 migrated from rural territory in certain divisions to rural territory in other divisions. In the second

decade only about half a million rural emigrants left the United States, but 890,000 migrated from rural districts of one division to those of another. The cities to which the urban-bound rural emigrants were drawn in the first decade are located predominantly in the east. Cities of the Middle Atlantic and East North Central States absorbed six-tenths of the rural migration to cities in 1890-1900. The second decade, however, saw a change in this respect; cities of the Pacific States captured a larger number of the rural emigrants than cities in any other division. Adding together rural and urban gains from native migration, the West South Central, Mountain, and Pacific Divisions received three-fifths of the rural emigration of the country. The movements of the two decades may be summarized by saying that in 1890 to 1900 the trend was from the rural districts primarily to the cities of the North-east, while in the second decade the trend was primarily toward the cities and rural districts of the northwest, west, and south-west.

Additional analyses might be made from Table 11 of the make-up of the migration to the cities of the various divisions, but for the present attention will be turned to the effects of the rural exodus upon the rural districts. Taking the rural area of the country as a whole, native whites of native parentage five to 14 years of age in 1890 numbered about 7,464,000. Of these .955 survived until 1900, or 7,125,000, and out of this number 294,000 or 4.1 per cent emigrated from the rural districts during 1890-1900. If this same group of survivors is traced through the second decade, it is found that .947 of them would have survived, at rural mortality rates, until 1901, or 6.750,000, of whom 278,000 would be the survivors of the emigrants of the previous decade, and 6,672,000 would be survivors of those who remained in the rural districts during the first decade. Of this last group, however, 8.6 per cent emigrated during the second decade, or 556,000. Thus, out of 6,750,000 persons who would have survived in 1910 of the rural inhabitants five to 14 years of age in 1890, approximately 834,000 had emigrated, or 12.4 percent. The rural area as a whole, therefore, lost through emigration, just about one-eighth of its potential parents of native stock during the twenty years while they were coming to maturity.

Because it was not practicable to derive migration estimates by

TABLE 14
Rural Migration Rates

Percentages which net rural emigrants or net native rural immigrants constituted of survivors in the same groups, by divisions, 1890-1910. Derived from supporting data of Table 11.

Division	Native whites of native parentage				Native whites, foreign or mixed parentage				Negroes			
	1890-1900		1900-1910		1890-1900		1900-1910		1890-1900		1900-1910	
	5-14	15-	5-14	15-	5-14	15-	5-14	15-	5-14	15-	5-14	15-
United States	—4.1	—7.0	—2.8	—4.1	—2.9	—.3	—7.2	—7.3	—6.7	—12.2	—9.2	—13.3
New England	—.5	—5.6	—.7	—13.1	.8	—2.0	—5.0	—5.5	55.9	—1.1	30.0	—7.9
Middle Atlantic	—6.5	—7.6	—4.2	—4.0	—6.7	—3.7	—4.1	—5.1	63.6	4.8	40.3	.3
East North Central	—5.9	—8.7	—8.6	—9.0	—5.1	—1.8	—12.9	—12.8	1.9	6.1	.0	—6.6
West North Central	—10.3	—13.1	—9.3	—11.6	—4.5	—2.2	—9.5	—12.8	—13.7	—18.0	—15.2	—16.2
South Atlantic	—4.6	—7.0	—3.5	—6.0	—1.9	—5.0	—5.0	—4.6	—11.0	—15.4	—10.1	—15.0
East South Central	—8.1	—10.7	—10.8	—13.1	—2.7	—3.9	—25.1	—19.6	—5.7	—11.8	—13.2	—17.1
West South Central	9.6	6.9	9.0	7.5	12.3	27.6	—7.0	—.6	—4.2	—8.6	—4.7	—6.3
Mountain	26.7	9.4	42.6	38.8	14.7	23.6	8.1	13.6	?	?	122.2	2.9
Pacific	8.0	4.4	44.6	42.8	6.4	13.7	18.3	29.3	?	?	66.0	58.4

ten year periods for each division it is not possible to make a detailed calculation similar to the above for each. Table 14 however, shows by divisions the percentages which emigrants constituted of survivors, classified according to the age distributions available by divisions. The migration of persons over 14 at the beginnings of the decades occurred largely during the ages 20-29, but the survivors are chiefly of later ages. Hence the emigrants in this age group for the rural territory of the United States as a whole constituted only 4.3 percent of the survivors in 1910 instead of 8.6 as was found to be the case when only the group 15-24 in 1900 was considered. Bearing this in mind it becomes evident from Table 14 that the West North Central and the East South Central States lost before 1910 through migration about one-third of the survivors of the native-born persons of native parentage who were 5-14 years of age in 1890. The East North Central and South Atlantic Divisions suffered in somewhat less degree, but more severely than the rural districts of the United States taken as a whole. Losses of native whites of foreign parents were even greater in some divisions, relative to the number of such persons in the divisions. Among some of the southern divisions it seems evident that 40 to 50 percent of the growing negroes emigrated from the rural districts during the twenty years in question.

A preliminary announcement of the results of the 1920 census, issued October 7, 1920, states:

> The figures of the present census also show that the trend of population from the country to the city has become greatly accentuated since 1910.

8. CONCLUSIONS FROM CHAPTER II

1. Over one-fifth of the native-born persons in the United States were born outside of the states in which they were living in 1910.

2. Methods previously in use for estimating migration are not satisfactory.

3. More useful and reliable estimates of migration may be derived from the comparisons of age—distributions at successive censuses, with allowances for intervening deaths.

4. A quarter of a million or more persons per decade born in families classified as negro report themselves as members of the white race, and foreign-born persons are reporting themselves in large numbers as native-born.

5. Over three-quarters of the foreign immigrants over 10 years of age enter the United States, and about the same percentage of native emigrants from rural districts leave their birth places, at the ages of 10 to 29. Migration to cities occurs at earlier ages than immigration or emigration; over half of the net migration to cities occurs at the ages 10 to 19. The migrants, therefore, were chiefly potential parents.

6. Emigration from the rural districts of the United States amounted to over two and one-half millions in 1890 to 1900, and to over three millions in 1900 to 1910.

7. Of the rural emigrants in 1900 to 1910, about one-sixth left the United States, over half went to cities of the United States over 25,000 in population, and less than one-third went to rural districts in other divisions.

8. In 1890 to 1900 the trend of interstate migration was from the rural districts primarily to the cities of the north-east. In 1900 to 1910 the trend was primarily toward the cities and rural districts of the north-west, west, and south-west.

9. The West North Central and East South Central States lost before 1910 through migration about one-third of the survivors of the native-born persons of native parents who were five to 14 years of age in 1890.

10. Preliminary census announcements for 1920 state that the trend to the cities has become greatly accentuated since 1910.

III. CHARACTERISTICS OF NATIVE MIGRANTS IN THE UNITED STATES

The significance of migration in relation to the character of the parenthood of a community lies chiefly in the differences which exist between the migrants and the individuals who do not migrate. In the present chapter two sorts of evidence as to the characteristics of migrants will be examined; first statistical data and second the reports of observers of pioneers and settlers. The character of migrants in the United States as ascertained from these sources will then be analysed with a view to determining its fundamental elements, and with a view to ascertaining the factors which determine it.

9. STATISTICAL EVIDENCE AS TO CHARACTERISTICS OF MIGRANTS

The data utilized in the following analyses were collected in three ways: first are the measurements of union recruits in the Civil War; second are the enumerations of the United States Censuses; and third are the data presented in Who's Who in America. None of these data were collected with a view to proving anything about pioneers or native migrants. All of them were collected with an impartial view to securing certain information on a comparable basis from the various sections of the country. The correlations pointed out below were apparently entirely unthought of by the compilers of the original data. The result is that while the information available does not provide a complete picture of the migrant, the facts which may be deduced from the statistics have an impartial scientific character.

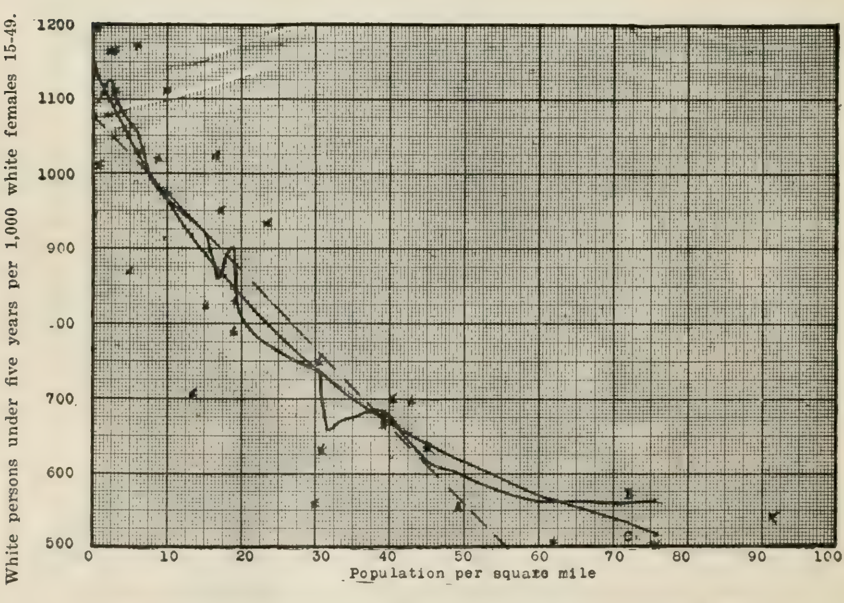
Fecundity of the Pioneers

The first characteristic of the western settlers which is apparent from the analysis of available statistical data is their high fecundity. Although no reliable statistics as to birth rates in the western states were available in the past century, it is possible to measure fecundity quite satisfactorily by means of the number of children under five years of age per 1000 women of child bearing age.

Such indices have been prepared for each state in the United States for each census from 1830 to 1900 by Walter F. Wilcox (*129*). The best index of the degree to which a population was made up of pioneers in years previous to 1850 (when census reports of the state of birth of the native population began) is the density of the population (*125* p. 44); for the states with the least dense population were the ones which were being settled by the frontiersmen of the most pronounced type, while the states with the densest population were no longer frontier territory. The fecundity of the early pioneers as compared with that of other types in the United States may therefore be analysed by means of the correlations between these two indices for the various states.

Between the number of persons per square mile and the number of white persons under five years of age per thousand white females 15 to 49 years of age in the states of the United States for which such data are available for 1830, the Pearson coefficient of

CHART 5



DENSITY-FECUNDITY CORRELATION GRAPH, 1830

showing rectilinear regression line (A), moving average (B), and curvilinear regression line (C). (Data from *125* p. 44; *129*)

correlation is —.832 ± .044. For 1840 the corresponding coefficient is —.769 ± .053. In calculating these coefficients states with densities over 75 per square mile were omitted.

These very high negative correlations indicate definitely that there was an inverse relationship at these dates between the density of population and fecundity. They indicate that this relationship was somewhat less exact in 1840 than in 1830. In order to ascertain what the relationship was between these two variables it is necessary to study the regressions. The correlation graph for 1830, as shown in Chart 5, suggests that curvilinear regressions would more correctly interpret the data than rectilinear. The rectilinear regression of fecundity of density is indicated by the dotted line. The equation of this line for 1830 is:

$$Y = 1078 - 10.4X$$

If the states are arranged in the order of their densities, and the fecundity indices are averaged in groups of five so as to secure a moving average the values indicated by the irregular solid line are the result. Using this irregular line as a basis, a regular curve may be derived, as indicated by the solid curved line which fits the data more closely than the rectilinear regression. The equation of the curved regression is:

$$Y = 294 + \frac{5,374,000}{(X + 79.5)^2}$$

If the mean square deviation in the Y dimension from this curve is divided by the mean square deviation of the Y's from their arithmetic mean, and if the square root of the difference between this quotient and unity be taken, the result corresponds in principle with the correlation ratio (*156*). The formula for the quantity, when

R = the modified correlation ratio,

S^2 = the mean square vertical deviation from the curvilinear regression, and

σ^2 = the square of the standard deviation, is

$$R = \sqrt{1 - \frac{S^2}{\sigma^2}}$$

This may be derived directly from the formula

$$s = \sqrt{1 - r^2}$$

which is similar to the formula for the errors of estimate in using a rectilinear regression line:

$$e = \sqrt{1 - r^2}$$

where e represents the error of estimate and r is the coefficient of correlation.

The deviations are measured in this case, not from the group averages as is done in calculating the correlation ratio, but from a regression curve fitted as closely as possible to the data. This curve undoubtedly represents more truly the tendencies of the data than the group means would, and the fitting of the curve is possible even though the number of items is too small to justify the use of the correlation ratio in its original form.

The closer fit of the curved regression line is indicated by the fact that the modified ratio of correlation secured is higher than the coefficient of correlation based upon the rectilinear regressions. In calculating the rectilinear correlation only the states with densities of less than 75 per square mile were included. For the sake of comparison of results the calculation has been made for this group, for all the states except the District of Columbia, and for all including the District. The correlations and modified ratios for each of these groups are as follows:

	States under 75 per square mile	All states except D. C.	All states including D. C.
Coefficients of correlation	—.832	—.819	—.737
Modified correlation ratio	—.859	—.833	—.852

All of the ratios are higher than any of the coefficients. It is evident, therefore, that the curved regression is a better basis for estimating the fecundity which corresponded with a given density than the straight regression.

On the basis of the curved regression the probable fecundity in a state with a density of two per square mile in 1830 would be about 1100, while in a state with a density of 30, which was about the condition of rural eastern states, the fecundity would be about 740. In urban territory, with densities of 500 the probable fecundity would be about 450.

Fecundity and Recent Migration

It is a well-recognized fact that the birth rate in rural districts of the United States is higher than that in urban districts. The 1910 census furnishes data (*125*, pp. 425, 427) for the following indices:

Native white persons of native parentage under five years of age per 1000 native white females 15-44 years of age.

In urban territory 266
In rural territory 550

Foreign-born white and native-born white persons of foreign or mixed per 1000 native white females 15-44 years of age

In urban territory 720
In rural territory 1239

Because of the factor of mixed parentage only the urban-rural contrasts in the above indices are valid. It is clear, however, that the net birth rate in the cities is between a third and a half lower than that in the rural districts.

This comparison between city and country is not an adequate basis for judging the relationship between migration and fecundity, for certain rural areas have been gaining rather than losing through migration, while certain cities have gained very little or nothing from native migration. A more useful comparison therefore is between gaining and losing districts whether urban or rural. The basis for such a comparison is given in Table 15.

When the rural and the urban territories are taken separately the relationship between migration and fecundity is very small. In the rural districts a slight tendency is apparent for the divisions gaining through migration to have somewhat greater fecundity than the divisions losing through migration, but the trend is so slight that it cannot be positively asserted. A similar and rather

TABLE 15

Recent Migration and Fecundity

Comparison, for rural and urban communities, by divisions, of the net native white migration during 1900 to 1910, per 1000 survivors of the 1900 population, with the numbers of native white children of native parentage under five years of age per 1000 native white females 15-44 years of age in 1910. Urban means, in connection with migration, cities of over 25,000, while in connection with fecundity it means incorporated places over 2,500. Derived from supporting data of Table 11 and from *125*, pp. 425-428.

Division	Rural		Urban	
	Migration rate	Fecundity index	Migration rate	Fecundity index
New England	—89	373	—8	210
Middle Atlantic	—42	427	11	247
East North Central	—100	454	122	260
West North Central	—111	474	142	270
South Atlantic	—49	673	103	355
East South Central	—126	693	271	358
West South Central	71	704	372	370
Mountain	306	551	423	295
Pacific	378	410	939	221

more marked tendency is apparent among the urban districts, for those divisions where the cities are gaining more rapidly from native migration have also somewhat higher urban fecundities on the average than other divisions. When, however, the rural and urban territories are combined the relationship is reversed, and the sections gaining most rapidly through native migration are lower in general in their fecundity than those losing through migration. The correlation between gains through native migration and fecundity for the urban and rural districts together is $-.400 \pm .133$. The regression of fecundity on rate of migration is represented by the equation:

$$Y = 933 + 3.42X$$

According to this equation areas losing one-tenth of the survivors of their native white populations in 10 years tend to have native white fecundity rates of approximately 467 children under five years per 1000 women of child-bearing age, while areas gaining in 10 years through native white migration numbers equal to 50 percent of the survivors of the native whites at the beginning of the decade tended to have native white fecundity rates of approximately 324.

The conclusions justified by these data are that the migrants to rural districts in the west show very little if any tendency to higher fecundity than the individuals left behind in the more Eastern rural districts, and that the migrants to cities show a distinctly lower fecundity than the individuals left behind in the rural districts.

Height

A second characteristic of the western settlers is evident from the large proportion of tall men among recruits from the western states in the Civil War, as compared with recruits from the eastern states.

This difference may be shown by the correlation between the percentages of the native-born free population in 1860 born outside the states of residence (*117* pp. xxxiii and 616 ff.) and the percentages of the union recruits from the respective states measuring 71 inches or over in height (*102*). The former percentage indicates the extent to which the populations of the various states and territories were made up in 1860 of first generation native migrants, and therefore is an index of the extent to which the

various populations were of the pioneer type. The percentage of recruits 71 inches or over in height indicates the prevalence of tall men among the elements of the population enlisting. The correlation between these two variables is $.631 \pm .084$. The regression equation for percentage of tall men on percentage born outside the state is

$$Y = 6.84 + .1121X$$

This means that the tendency was for tall men to be about twice as numerous among the recruits from the recently settled states as among recruits from the older states. Where 80 percent of the native free population was born outside the state the tendency was for 15.8 percent of the recruits to be five feet eleven inches tall or over; where only five percent were born outside the state only 7.4 percent of the recruits were as tall as five feet eleven inches. The size of the correlation coefficient, and the fact that it is seven and one-half times as large as the probable error, indicates that this tendency was very clearly marked.

Contributions of Civil War Troops

Another source of light upon the character of the western settlers is the data as to the number of troops furnished in the Civil War by the various Union states. It must not be supposed that the number of troops furnished was determined in the Civil War by the draft. Major General Crowder says: "The number actually drafted into the army was but 46,347." (*136*). As an index of the contributions of soldiers by the various states the number of white troops furnished on a three year basis, as reported by Fox (*103*) was divided by the number of white males 20 to 29 years of age (*117* p. 592). These white males include the foreign-born, but there is no appreciable correlation between the proportion of foreign-born in the population (*117* pp. 606-607) and the proportion of troops furnished. Only the Northern states, excluding the border slave states of Kentucky, Maryland, and Missouri, and only the states accessible to railroad transportation (*145*) were considered. The index for the prevalence of pioneer conditions in the various states is the percentage of the native-born free population in 1860 born outside the state of residence. Table 16 shows the data for the states considered and for those excluded. The correlation between the two indices is $.634 \pm .093$. The regres-

TABLE 16

TROOPS PROVIDED IN THE CIVIL WAR BY NEWLY SETTLED STATES AS COMPARED WITH OLDER COMMUNITIES

State or Territory	Percentage of native-born free population born outside state of residence, 1860. (*117*)	White troops furnished, on a three year, basis, per 1000 white males 20 to 29 years of age. (*103*)
Northern states accessible to railroads		
Kansas	88.4	1172
Minnesota	69.7	1056
Iowa	66.4	1131
Michigan	50.9	1050
Wisconsin	50.5	1175
Illinois	49.0	1210
District of Columbia	42.7	1190
Indiana	37.1	1233
Ohio	23.9	1123
Rhode Island	19.9	887
Massachusetts	17.0	886
Delaware	16.2	945
New Hampshire	15.8	1072
Vermont	15.3	1022
Connecticut	14.7	1105
New Jersey	14.6	785
New York	9.7	994
Pennsylvania	7.9	890
Maine	5.2	918
Non-Confederate States inaccessible to railroads		
Colorado	99.7	208
Nevada	96.3	347
Nebraska	84.6	454
Washington	75.6	302
California	66.7	182
Oregon	65.0	245
Dakota	48.2	525
Utah	41.9	....
New Mexico	2.7	478
Border Slave States		
Missouri	47.6	716
Kentucky	17.1	525
Maryland	7.9	571

sion equation for troops furnished per 1000 men 20 to 29 years of age, on percentage of population born outside the state is

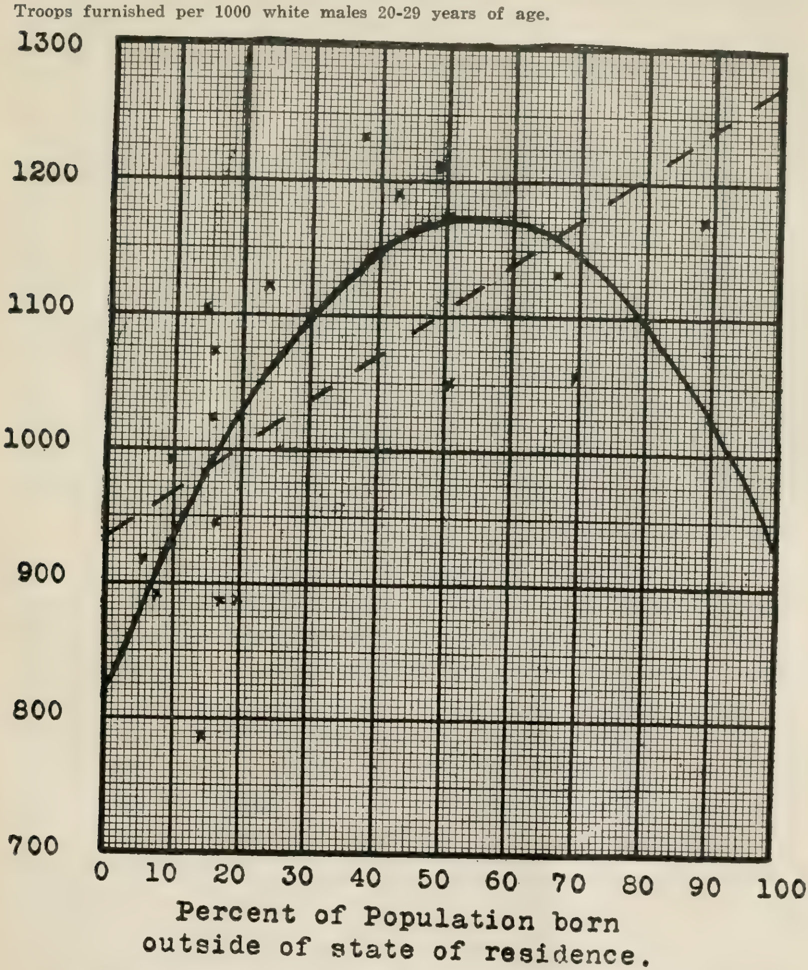
$$Y = 933 + 3.42X$$

On the basis of this equation the number of troops furnished per 1000 men 20 to 29 years of age would be 1200 in states where 80 percent of the population was born outside the state, and 950 in

states where only five percent of the population was born outside the state.

The correlation graph, Chart 6, indicates however that the rectilinear regression is not the curve best fitting the data. A regression curve whose formula is

CHART 6



CONTRIBUTIONS OF CIVIL WAR TROOPS AND RECENCY OF SETTLEMENT

in Northern states accessible to railroads, shown in correlation graph with rectilinear and curvilinear regressions. Data from Table 5.

$$Y = 1173 - \left(\frac{X-55}{2.88}\right)^2$$

fits more closely than the regression line described by the preceeding formula. This curve is shown on the chart. The root-mean-square deviation from this regression line is 91.1 as compared with 97.6 from the rectilinear regression, and the modified correlation ratio is .692 as compared with the coefficient of correlation of .634. It is clear therefore that the curved regression more closely represents the relationship between the two variables than the straight line. According to this regression the furnishing of troops reached its maximum in states where about half of the population was born outside the state, where the ratio was 1173, and fell to its lowest point in the oldest states. In states with five percent born outside the state the probable rate of troops furnished would be 871. The recently settled states thus furnished fully one-third more troops, relative to their population of suitable age and sex, than did the older states. The failure of the extreme frontier states to equal the record of the recently settled states was probably due to the fact that while the railroads had begun to penetrate the outlying territories they were still sufficiently isolated to diminish their realization of the urgency of the call to arms, and to increase the difficulty of reaching points of enlistment, and the difficulty of enforcing the draft.

Divorce and Interstate Migration

A very marked tendency of interstate migrants toward divorce is evident from analysis of data presented by the Bureau of the Census. The most available data for the present purpose are those of 1890. The index used here of the prevalence of interstate migrants in the population is the percentage of the native-born population born outside the state of residence. The index of the prevalence of divorce used is the number of divorced persons per 100,000 married persons. The correlation between these two indices is $.684 \pm .050$. Divorce is thus shown definitely to have been more prevalent in states with large percentages of interstate migrants in their population than in other states, in 1890. The extent of the difference is shown by the regression equation:

$$Y = 3.07X + 81.5$$

where Y represents the number of divorced persons per 100,000 married persons, and X represents the percentage of the native-

born population born outside the state of their 1890 residence. Substituting 80 and 5 for X in the equation it is evident that the tendency is for the divorce rate in states chiefly peopled by migrants to be 327.1 while in states with very few such migrants the rate tends to be 98.6, or less than one-third as great. The correlations may reflect chiefly a tendency of recently settled states to adopt laxer divorce laws with consequent attractions of persons wishing to secure divorces.

Homicide and Interstate Migration

Homicide has been more prevalent in recently settled states than elsewhere. Because of the lack of accurate statistics for earlier years the data used in this connection are the homicide rates for the years, 1915, 1916, and 1917 as reported in census returns on Vital Statistics. (*127*). In order to eliminate the influence of variations in the percentages of urban population in the several states only the death rates in the rural sections were considered. As an index of the proportion of interstate migrants in the populations the percentages of the native rural population born outside the states of residence in 1910 were used. The correlation between these two indices is $.554 \pm .096$. The regression of rural homicide rates on percentages of native rural population born outside the state of residence in 1910 is

$$Y = .297X + 7.55$$

where Y represents the sum of the annual death rates from homicide per 100,000 of population for the three years, and X is the percentage of migrants. Thus the tendency is for the homicide rate to be 9.03 in a 95 percent non-migrant rural population and 31.31 in an 80 percent migrant population. In other words, the homicide rate has tended, even in very recent years, to be three times as great in a rural community made up chiefly of migrants as in a rural community made up chiefly of non-migrants.

Literacy and School Attendance

In connection with literacy and school attendance also the recent data are preferable to those of previous censuses because the 1910 returns distinguish between urban and rural communities, and between racial and nativity groups. In the next three correlations the same indices of proportion of native rural population born outside the state of residence are used as in the homicide correlation. For literacy the index used is the percentage of the native white

persons of native parentage in rural districts in 1910 who were illiterate. (*125* pp. 1208 ff.) The correlation here is —.427 ± .081. If the linear regression equation is used, and 0 and 100 percent are substituted for X the tendency indicated is for the percentage of illiteracy among native whites of native parents in a wholly non-migrant rural community to be 7.24 as compared with —3.38 in a wholly migrant community. Since a negative percentage of illiteracy is absurd it is evident that the true correlation here is curvilinear. A curve represented by the equation

$$Y = \frac{6{,}453}{(X+19)^2} - .18$$

fits the data better than the straight regression line. The modified correlation ratio around this curve is .493 as compared with the rectilinear correlation of .427. If 80 and five are substituted for X in the above equation the corresponding values of Y are .5 and 11.0 respectively. Thus the illiteracy among native-born whites of native parentage in a thoroughly migrant rural community tends to be about one-twentieth what it is in a thoroughly stagnant community.

The correlations between the percentages of interstate migrants in the rural population and the percentages of native white persons of native parents 10 to 14, and 15 to 20 years of age in rural districts attending school (*125* pp. 1148 ff.) are much lower than the correlations discussed above. For the earlier age the correlation is .277 ± .091; for the latter it is .256 ± .097. The regressions indicate that a rural community in which 80 percent of the native whites were inter-state migrants 94.9 of the native whites of native parents 10 to 14 years of age would probably be attending school as compared with 89.4 percent in communities containing only five percent of such migrants, while the corresponding figures for the ages 15 to 20 would be 45.5 and 40.6. The relationship is not so clearly proven, but the probability is established that in rural districts interstate migrants are decidedly more likely to be attending school or to be sending their children to school than non-migrating individuals.

Journalists and Lawyers among Interstate Migrants

Lawyers and journalists have been especially numerous in states inhabited chiefly by natives of other states. Between the percentages of the native white population in 1870 born outside the states of their residence and the percentages of occupied persons in the

respective states in 1870 who were journalists (*118* pp. 674 ff.) there is a correlation of .630 ± .067. The regression indicates a tendency for .071 percent of the occupied population to be journalists in a state having 80 percent of interstate migrants in its native population as compared with .028 percent in a state with five percent interstate migrants. For lawyers the corresponding correlation is .582 ± .073. In a state in which 80 percent of the native white population were born outside the state .55 percent of the occupied persons would probably be lawyers, while in a state where 95 percent of the native whites had been born in the state the percentage of lawyers would probably be .23. Thus both lawyers and journalists tended to be two and a half times as frequent among populations made up of interstate migrants than they were among non-migrant populations.

The Production of Distinguished Individuals and Interstate Migration

On the basis of *a priori* reasoning it seemed probable that the pioneer stock would tend to produce an unusually large number of distinguished persons. In order to test the soundness of this hypothesis analyses were made of the return in Who's Who for 1920-21. (*113*). It is recognized that the selection of persons for inclusion in Who's Who is not made by rigid scientific tests and that many persons of mediocre ability may be included because of positions which they hold or notoriety which they have achieved. It cannot be denied, however, that the vast majority of the persons who have attained real distinction are included in the volume, and that the average intelligence and ability of the persons in Who's Who is unquestionably vastly higher than that of persons not included.

The analysis of the data in Who's Who is complicated by the fact that in order to compare the various states fairly as to their production of men and women eminent enough to be included in that volume it is necessary to divide the number of persons listed as born in each state by the number of persons born in the same state at the dates when the persons in Who' Who were born, or by some index closely correlated therewith. Since the persons listed in 1920 were born at dates ranging over more than fifty years, and since the population of the various states were increasing at very different rates during that period the problem is a complex

one. As a preliminary test a sample of 1000 names were tabulated according to the date and state of birth, grouping the states according to the percentages of the native-born free population in 1860 born in the state. On the basis of this sample the percentage of the Who's Who individuals born in each group of states in the decade 1855-64 was estimated, and these numbers were divided by the white populations of the respective groups of states less than one year of age in 1860. It is believed that this forms a better index than to use the entire populations of the states as bases as other investigators have done, for the proportion of young children varied greatly in the several states, as has been pointed out earlier in this study. The results of the above analysis are summarized in Table 17. It will be noted that the number of distinguished persons produced per 1000 white infants in 1860 shows a very definite inverse correlation with the percentage of the populations born in

TABLE 17

PRODUCTION OF DISTINGUISHED PERSONS AND RECENCY OF SETTLEMENT, 1855-64

Estimated number of distinguished persons born in 1855-64 per 1000 white persons under one year of age in 1860 in states classified according to the percentage of the native free population of the state in 1860 born in the state of residence. (*113*; *117* pp. xxxiii, 592, 616 ff.)

Percent native free population born in state of residence	Persons listed in Who's Who born in specified class of states			White persons under one year old in 1860	Distinguished persons born 1855-64 per 1000 under one year 1860
	Total	Estimated as born in 1855-64			
		Percent	Number		
90-99	7,454	29.1	2170	278,013	7.8
80-89	5,145	28.2	1450	157,867	9.2
60-79	2,890	25.6	740	141,363	5.2
40-59	3,456	23.5	812	162,131	5.0
20-39	1,251	20.3	254	53,117	4.8

the state of residence at that date. The coefficient is .83 ± .09. The frontier did not produce its share of distinguished men and women. The consistency of the results from group to group indicates that the sample is large enough to yield reliable deductions. The group of states with 80 to 89 percent of its native free population born in the state of residence, which is the second group in the table, contains all of the New England States but Maine, which is in the first group. This fact is in harmony with Nearing's conclusion that the New England states have had the lead in producing distinguished persons. (*115*).

The fact that the more settled states are those with the largest proportions of urban population, and the fact pointed out by Nearing that the cities produce more than their share of the distinguished persons, suggests that possibly this may be the reason for the deficiency of the frontier states in the production of great men. The lack of data as to the percentages of urban population in the various states previous to 1880 makes it difficult to determine this point with finality, but a study of the available data suggests that probably the frontier states produced fewer distinguished persons per 1000 white children in 1870 than older states of similar percentages of urban population. The very recently settled states appear to have done better than the half-way states.

In order to study this question independently of such confusing factors as the proportion of urban population, presence of negroes, and differences in rate of population growth, a limited investigation of the New England and West North Central States was made. In 1870 the West North Central States were the most recently settled of the states with any considerable population, while the New England States were among those with the fewest interstate migrants living in them. These two groups of states, therefore, typify the migratory and non-migratory types of population as well as can be done by a contrast between two divisions. From every fifth page of *Who's Who in America* for 1920-21 all of the persons born in these states were tabulated according to date of birth and whether or not they were born in cities having in 1870 populations over 10,000. The birth-date distribution of all the persons in Who's Who born in the United States was determined by means of a sample of 1000 names. The percentages of the distinguished persons born in the United States who were produced by the urban and rural portions of the two divisions were deduced from these sample data. The percentages of the total population of the United States living in the urban and the rural districts of the divisions in question at each census from 1850 to 1890 were then determined.

Unfortunately the numbers of persons under one year of age are not reported for the cities. If the normal production of distinguished persons by an locality may be said to be indicated by the population of that locality at the dates of birth of such persons,

then the percentage of normal production is indicated by dividing the proportionate population by the proportionate production of distinguished persons. Thus the cities considered in the New England States contained 2.44 percent of the population of the United States in 1850. Of the persons listed in Who's Who as being born in the United States in the years 1845-54, 9.9 percent were reported as being born in these cities in the New England states. The urban territory of New England therefore produced 3.3 times its quota at this period. Similar indices for the various decades and for the areas in question are shown in Table 18.

TABLE 18

PRODUCTION OF DISTINGUISHED PERSONS IN URBAN AND RURAL SECTIONS OF THE NEW ENGLAND AND WEST NORTH CENTRAL STATES

Quotients of the percentages of distinguished persons born in the United States at various periods and listed in Who's Who for 1920-21 who were born in the specified areas, divided by the percentages of the population of the United States resident in the respective areas at corresponding dates. (*113*, *125*).

Period	New England States		West North Central States	
	Cities of over 10,000 in 1870	Other areas	Cities of over 10,000 in 1870	Other areas
Average	2.8	1.6	1.6	.9
1845-54	3.3	1.7	.8*	.8*
1855-64	2.5	2.0	2.6*	1.0
1865-74	2.3	1.4	1.4*	.8
1875-84	2.6	1.6	1.8*	.7
1885-94	3.3*	1.4*	1.4*	1.3*

* Items starred are based on samples containing less than 25 individuals.

Chronological conclusions may be drawn from Table 18 only with conservatism. The number of items in the samples, particularly in the urban section of the West North Central States is too small to justify conclusions as to the trend of the production of distinguished persons in these areas from decade to decade. The springing up in the later decades of new cities not included in the list used tends to disturb the character of the rural areas. The general averages, however, involve sufficient numbers to be quite reliable. It is entirely safe to conclude that the cities of these divisions have been producing approximately 70 percent more persons of distinction, relative to their populations, than the rural areas, and that both the cities and the rural districts of the New England States have produced approximately 75 percent more persons of distinction relative to their population than the

cities and the rural districts respectively of the West North Central States. The data certainly give no justification for the assumption that either division is improving in the number of distinguished persons produced.

Light is cast upon the reasons for the failure of the migrant stock to produce more than its quota of distinguished persons, by the correlations between the prevalence of certain professions in the 1870 populations and the production of distinguished persons in the present generation. An investigation of the occupational distribution in the professions of the populations in 1870 indicates that the professions most likely to be unusually prevalent in the states producing more than their quota of distinguished persons were "authors and lecturers," "librarians," and "painters." A correlation was also apparent with the prevalence of "inventors," "artists," "musicians," "sculptors," and clergymen, but the best correlation was secured by the use of an unweighted average of indices of the prevalence of the first three occupations named. This index was secured in the case of librarians, for example, by finding what percentage of the librarians of the United States in 1870 were resident in each state, and then dividing these percentages by the percentages of all occupied persons in the United States residing in the respective states. If the resulting index was 2.0 it indicated that the state in question had twice as many librarians as would be expected from the total number of occupied persons in the state.

The occupations used in this index are obviously likely to be most prevalent in the communities in which there is the most interest in intellectual and artistic matters, in the production and appreciation of books, paintings, and lectures. Hence the average of the indices for the three occupations used may well be referred to as a culture index. Since this index is based upon all occupied persons irrespective of color, it is correlated with an index of production of distinguished persons secured by dividing the number of Who's Who individuals born in each state by the number of individuals both white and black under one year of age in the respective states in 1870. The correlation between these two indices is $.669 \pm .060$. The regression is such that when the culture index is zero the number of distinguished persons produced per 1000 persons under one year tends to be 12.1 whereas when the

TABLE 19

PRODUCTION OF DISTINGUISHED PERSONS IN RELATION TO PREVALENCE OF CULTURAL OCCUPATIONS, (*113; 118*, pp. 674 ff.)

State	Persons in Who's Who per 1000 persons under 1 year in 1870	Index of prevalence of authors, lecturers, librarians and painters among occupied persons in 1870	Percentage of occupied persons in 1870 who were clergymen
New Hampshire	61.30	1.27	.552
Massachusetts	59.55	4.23	.352
District Columbia	54.90	....	.354
Connecticut	50.75	3.95	.469
Vermont	47.15	.92	.543
Maine	41.37	1.11	.427
New York	32.30	1.67	.381
Colorado	29.15	....	....
Nevada	28.20	.76	.135
Delaware	23.18	.28	.372
Ohio	22.91	.91	.425
New Jersey	21.70	1.25	.418
Maryland	21.55	1.16	.362
Nebraska	20.45	.41	.417
California	20.40	3.95	.238
Oregon	19.39	1.53	.528
Michigan	19.06	.72	.354
Pennsylvania	18.91	.72	.376
Wisconsin	18.41	.64	.406
Minnesota	17.79	.86	.467
Virginia	17.35	.20	.260
Utah	15.50	....	....
Illinois	15.23	1.54	.430
Iowa	14.91	.46	.463
Indiana	14.56	.51	.389
Washington	13.16	....	.513
South Carolina	11.60	.09	.210
North Carolina	11.21	.04	.245
Kansas	11.12	.51	.435
Kentucky	10.76	.25	.260
Missouri	10.15	.50	.343
West Virginia	9.49	.14	.404
Alabama	8.65	.18	.245
Tennessee	8.49	.24	.341
Florida	8.00	.30	.324
Georgia	7.56	.12	.214
Texas	7.13	.38	.350
Louisiana	6.92	.25	.158
Mississippi	6.23	.06	.235
Arkansas	5.04	.00	.292
New Mexico	2.28	....	.174

culture index reaches its maximum of 4.3 the production of distinguished persons tends to be 50.7 or over four times as great.

A smaller correlation is evident between the prevalence of clergymen in the gainfully occupied population in 1870 and the production of distinguished persons. The coefficient here is $.424 \pm .092$. The indices used in calculating these correlations are presented in Table 19.

Since therefore the production of distinguished persons is fairly closely associated with interest in things intellectual, esthetic, and spiritual, the failure to produce a large number of distinguished individuals is probably symptomatic of lack of interest by the community in such things. It does not seem strange that the frontier has little time for art and literature, and that a recently settled environment should be unfavorable to the development of culture.

Of those who migrated to cities a greater percentage became distinguished than of those who remained in or migrated to rural districts. This is proved, relative to the urban and rural districts of the West North Central and New England States by an analysis of the data summarized in Table 18. In the New England States the number of persons listed as living in the cities which had more than 10,000 inhabitants in 1870 is 1.6 times as great as the number listed as having been born in those cities, while the number listed as living outside those cities in the New England States is only .4 as great as the number born outside. In the West North Central States the number living in cities which had a population of over 10,00 in 1870 is 2.5 as large as the number born in these same cities, while the number living outside those cities is only .7 as large as the number born outside. These contrasts are not so great as they would be if the migration to cities which have developed since 1870 were eliminated. Clearly, therefore, the migration to cities carries with it a highly excessive proportion of distinguished or potentially distinguished persons, or else the city environment develops latent possibilities which lie dormant in individuals remaining in the rural districts. Probably both conclusions are correct. Davies (*105*) thinks that he has proved by correlations that the city environment develops greatness, but he has failed to consider several of the vital factors in the problem.

With regard to the failure of the westward migrants to produce their share of distinguished persons, the theory of Frederick Adams Wood seems plausible in the light of the available facts:

The great western migration of the last century must have produced

a kind of natural selection. Very likely the west has been the gainer and New England the loser, from the standpoint of vigor, energy, and ambition. But it seems fair to suppose that while the better of the middle classes might have joined the emigrant trains the intellectual aristocracy did not. (*153*).

The intellectual aristocracy, it appears from the data discussed

TABLE 20

CHARACTERISTICS OF INTERSTATE MIGRANTS AS INDICATED BY CORRELATIONS

A Summary Table.

Date of data	Characteristic of population	Probable degree of characteristic		Coefficient of correlation or correlation ratio
		In recently settled states*	In states containing few migrants*	
1830	White children under five per 1000 white females 15-49	1104	740	.852 ± .034
1910	Native white children of native parents under five years, native parents per 1000 native white females 15-44	324	467	—.400 ± .133
1860-65	Percent of Union recruits 71 inches or over in height	15.8	7.4	.631 ± .084
1860-65	White troops furnished on three year basis per 1000 males 20-29 years of age	1173	871	.692 ± .085
1890	Divorced persons per 100,000 married persons	327.1	98.6	.684 ± .050
1915-17	Deaths from homicide in three years in rural sections of registration states per 100,000 population	31.3	9.0	.554 ± .096
1910	Percent illiterate among native whites of native parents 10 years and over in rural districts	.5	11.0	.493 ± .064
1910	Percentage attending school among native whites of native parents in rural districts, at ages			
	10-14	94.9	89.4	.277 ± .091
	15-20	45.5	40.6	.256 ± .097
1870	Percentage of occupied persons who were			
	Journalists	.071	.028	.630 ± .067
	Lawyers	.55	.23	.582 ± .073

*The terms "recently settled states" and "states containing few migrants" must be interpreted in each case in accordance with the text discussions of the respective correlations.

above, tended to migrate to the cities, rather than to the western rural districts.

Summary of Conclusions from Section 9

The conclusions reached in the analyses of the above section may be summarized as in Table 20.

The characteristics indicated by these correlations are fecundity, tallness, readiness to enlist in a national emergency, interest in education, and in newspapers and periodicals, absence of persons of decidedly inferior intelligence, and self-assertiveness or quarrelsomeness as indicated by high homicide rates, large numbers of lawyers and probably by the high divorce rates.

In addition to the characteristics therein listed it has been proven that the city environment creates distinguished persons out of rural-born material or that migration to the cities includes a disproportionately large number of the potentially distinguished. Persons born in recently settled states appear not to include the usual quota of those destined to become distinguished while those born in cities include an unusually large proportion of such persons. The West North Central States, even with the factor of urban concentration eliminated, produce far fewer distinguished persons than the New England States. The production of distinguished persons is decidedly associated with interest in intellectual, artistic, and spiritual matters, and therefore the frontier presumably failed to attract in large numbers the intellectually elite.

10. THE CHARACTER OF THE PIONEER AS DESCRIBED BY OBSERVERS

The picture of the interstate migrant which can be secured from correlations in the present state of sociological statistics is at best fragmentary. Statistics furnish impartial information on the points with regard to which they are available, but for a well-rounded picture it is necessary to use historical methods. The interstate migrant was to be found in a pure state on the American frontier. For supplementary information as to the type of individual migrating in the early days, therefore, descriptions by observers of the American pioneer have been utilized.

In order to secure as comprehensive and objective a description of the frontiersman as possible every accessible comment on the pioneer character was listed (*1* to *71*) and the adjectives used by

the writers were recorded and classified. The outstanding types of characteristics asserted of the pioneer were three in number: qualities suggestive of intensity of feeling and action, qualities suggestive of absence of inhibitions or of casting off or breaking through inhibitions, and characteristics indicative of capacity for coöperation. Among the qualities suggestive of intensity of feeling and action were energy, initiative, enthusiasm, intensity, emotionalism, optimism, active-mindedness, keen-wittedness, resourcefulness, interest in education, health and strength. Among characteristics suggestive of the absence or defiance of inhibitions were courage, adventurousness, recklessness, extravagance, tenacity, perseverance, restlessness, love of freedom, lawlessness, dissipation, sincerity, frankness, coarseness, crudeness, self-reliance, and democracy. Among characteritics suggestive of capacity for coöperation were sympathy, kindness, generosity, hospitality, tendency toward group colonization, and capacity for creating orderly government.

As a control on the data in the above classification a parallel analysis was made of the characteristics asserted in recent decades by observers of the populations of rural New England after the westward and city-ward migration had drawn off the individuals having pioneer characteristics. (*72-93*). The character of the residual rural New Englander, as depicted by these observers, is almost the exact antithesis of that of the pioneer. Deficient in energy, flaccid in emotion, unprogressive, lacking in capacity for coöperation, these descendants of the people whom the pioneers left behind exhibit the lack of the qualities for which the pioneer was distinguished. The notable exception to the contrast lies in the prevalence of dissipation in both groups, and even here there is discernable a distinction between the boisterous debauchery of the frontiersman and the degenerate vice of the residual New Englander.

11. ENERGY AS A FUNDAMENTAL CHARACTERISTIC OF THE PIONEER

Of the characteristics of the pioneer all those suggestive of intensity of feeling and action, and most of those suggestive of the tendency to break through inhibitions are explicable quite completely in terms of intense craving for activity and intensity of emotion. Recent investigators of the physiological conditions of

emotion give a theoretical basis for the belief that intensity of action and of emotion tend to arise from the same physiological conditions, and that individuals differ widely in their inheritance of these physiological conditions and hence in their tendencies relative to the expenditure of nervous energy. The present study cannot take up this phase of the matter in detail; a summary of the literature on the subject has been prepared by Holt. (*141*). The pioneer obviously was an individual of the highly energetic type.

12. THE ORIGIN OF THE PIONEER CHARACTER

As to the explanation of the source of the capacity of the pioneer for energetic feeling and action, four theories present themselves. First, it has been suggested that this is a race characteristic of the Anglo-Saxon. Second, it might be asserted that pioneer energy was the result of the youth of the pioneers. Third, it might be held that it was the result of the molding influence of the frontier environment. Fourth, it might be maintained that the influence of the frontier environment was selective in its action rather than formative. It is highly important, in considering the influence of migration upon child welfare, to determine the function of these four factors in producing the energy and the other characteristics of the pioneer. If the first theory is the most adequate one, and energy is a racial characteristic, then pioneer energy may be expected to survive to the extent that the race survives, and the important subject in the study of migration is the racial composition of the migrants. If the theory that youth is the explanation is correct the energy of the pioneers may be expected to crop out in the early years of each generation and disappear as its members grow older. If the energy was due to environmental reactions the pioneer character may be expected to disappear with the frontier, except in so far as social heredity carries it on. If energy was a characteristic derived by selection, it may be transmissible by heredity. The next few pages will be devoted to reviewing the evidence for and against these four theories.

Race as an Explanation of Pioneer Energy

Le Bon has suggested (*144*) race differences as the basis of variations in vigor. He holds that whereas the Anglo-Saxons are distinguished by indomitable energy, will power, and initiative, the Italians, Irish and Spaniards are lacking in such qualities.

This theory finds some ground in Irving's remark that the French trappers were lighter, softer, more self-indulgent and dependent than the Americans. (*37*: pp. 32-3). Timothy Flint speaks of the French Creoles as "mild and amiable people with less energy and less irascibility than the immigrants of other states." (*24*: pp. 567-8). Royce describes the Mexicans and Spaniards in early California as modest, unprogressive, not courageous, having no great endurance, free, careless, genial and charming. (*53*: pp. 30-34). Hittle speaks of the Mexicans as lacking in the activity and enterprise which distinguished the Americans. (*29*: p. 182).

On the other hand, Dunn refers to the French settlers in Indiana as resolute and courageous. (*20*: p. 129). Clemenceau says that Argentina (settled by the French and Spanish) overflows with energy. (*138*: pp. 84, 85, 92). Bryce, though he asserts in one place that the South Americans are less brusque, less strenuous in their work and less eager to get on than the North Americans, says in another place, speaking of the Conquistatores: "The fiery vigor of that extraordinary group of men has often blazed out in their descendants. It is the appearance in almost every state of men of tireless energy and strenuous will that gives their chief interest to the wars and revolutions of the last three hundred years." (*136*: pp. 504-5, 584). In still another place he asserts that there is plenty of energy in the southern republics but that it is not directed toward art or science. (*136*: p. 443).

This conflict of opinion suggests the necessity for some other explanation of the high endowment of energy which the pioneers displayed. The race theory would not explain differences between the characteristics of persons of the same race in the east and in the west, nor would it explain differences between the American and the British character.

Youth as an Explanation of Pioneer Energy

A number of authors observe the fact that the pioneers were predominately young people. The analysis of migration in Chapter III points out the same fact. Statistics for 1850 in selected states, as summarized in Table 21, corroborate their conclusion. The northeastern states with an excess of females were selected, as most nearly typical of the territory from which migration to the frontier was occurring and immigration from other places was at a minimum. The Carolinas also had more females than males but

TABLE 21

AGE AND SEX DISTRIBUTION AT THE FRONTIER AND ELSEWHERE

Percentage sex and age distribution in broad groups of the population in 1850 of four north-eastern states having more females than males (Connecticut, District of Columbia, Massachusetts, New Hampshire and Rhode Island), of five frontier states (Arkansas, Iowa, Michigan, Missouri, and Wisconsin), of five states outside the frontier (Florida, New Mexico, Oregon, Texas, and Utah), and of California. Source of data *119*.

Group or state	Percent of total population			
	Male	In age groups		
		0-19	20-49	50 and over
North-eastern	49.2	42.7	43.9	13.4
Frontier	52.8	55.7	38.1	6.2
Ultra-frontier	53.3	55.0	38.5	6.5
California	92.4	12.5	83.8	3.7

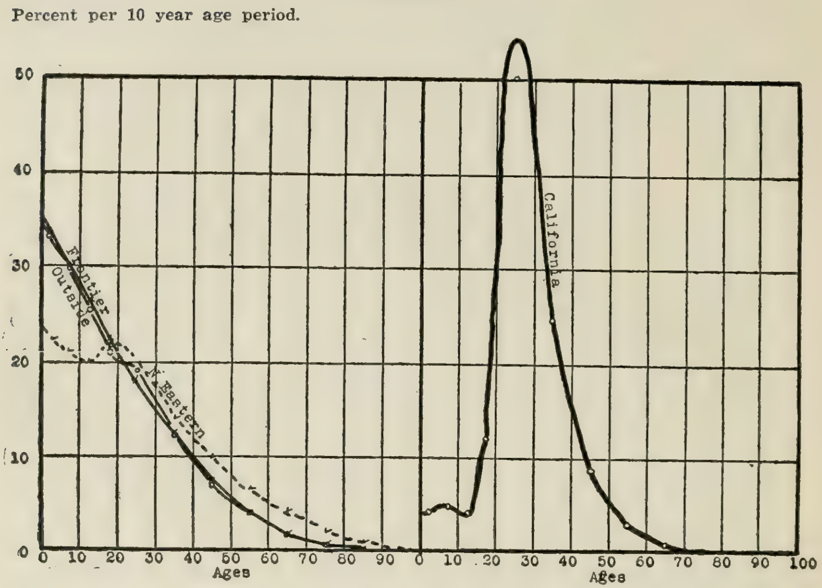
the age distribution in these states was of a different type. The "frontier" states selected are those which at this date were on the borderline between territory with over two persons per square mile and territory with less than that density of population. The "ultra-frontier" states are located outside this line. California was treated separately because the gold rush had produced a type of population decidedly different from that of other pioneer states. The data are presented graphically in Chart 7.

In examining these distributions as one proceeds from the eastern states westward the percentage of persons over fifty years of age drops one-half at the frontier, and in California is reduced to less than one-third the proportion appearing in the north-eastern states. In California four-fifths of the population was between 20 and 49 years of age. Indeed, more than half was between 20 and 29 years of age. In the other frontier and extra-frontier states, however, the proportion of persons in the prime of life is lower than in the northeastern states. The proportion of persons under 20 is one-fourth larger at the frontier than in the north-east, but is less than one-third as large in California.

Roughly, the California population represented the wilderness-breaker type of pioneer, the population of the states outside the frontier represented the cabin-builders, and the states on the frontier contained settlers. The north-eastern group approximates conditions in the least frontier area.

If the California population in 1850 stood alone, a fairly strong argument might be made to the effect that the great energy exhibited by the pioneer was due chiefly if not wholly to the selec-

CHART 7



AGE DISTRIBUTION AT THE FRONTIER AND ELSEWHERE IN 1850

Percentage age frequency curves for frontier states (Arkansas, Iowa, Michigan, Missouri, and Wisconsin), for north-eastern states with more females than males (Connecticut, District of Columbia, Massachusetts, New Hampshire, and Rhode Island), for states outside the frontier (Florida, New Mexico, Oregon, Utah and Texas), and for California. Source *119*.

tion of the most energetic sex and ages. The cabin-builders and settlers, however, had an excess of children rather than an excess of young people. The absence of the aged, and the predominance of males in the frontier states is not pronounced enough to explain the prominence of energetic characteristics in the pioneer character. Rather they are merely symptomatic of a selection which not only drew most strongly upon the vigorous ages and the more energetic and unhampered sex, but also attract from among the young the most aggressive, ambitious and heroic, and left behind, not only the aged and infirm, but also the youths who were lazy, listless and indifferent.

The Frontier Environment as a Molding Force

The frontier may be defined as the border land between settled

and unsettled country, the margin in which the wilderness was being populated and subdued. This border strip of country almost always had three characteristics which tended to have a great influence upon the character of the early settlers. These characteristics of the frontier were newness and thinness of population, and relative isolation from older centers of culture.

Newness and thinness of population were responsible for two important sub-characteristics. They usually prevented the presence of any ready-made, firmly-set social institutions. The frontier was an empty loom into which any social fabric might be woven at will. When, as in the case of the New England settlements, a complete social organization was introduced *en bloc,* the unsettled spaces beyond, where social institutions and traditions were absent, became in their turn the frontier. The other result of the thinness of population was the opportunity and necessity for economic self-dependence. (*3*: pp. 245-6; *34*: p. 122; *36*: I, p. 73; *46*: II, p. 271; *50*: p. 832; *65*: p. 219).

Closely allied with thinness of population in its results was the relative isolation of the frontier from the older centers of culture. The extreme of this characteristic occurred in the case of the Klondyke, where communication with civilization was possible only at long intervals and with great difficulty. The frontiers of Pennsylvania, Kentucky and Ohio were isolated from the older settlements by the Alleghany Mountains. (*51*: I, p. 116; *65*: p. 221 ff.) As the line of settlement moved westward the semi-settled strip was the only insulation between the old country and the new. The introduction of the railway and telegraph greatly decreased the degree of isolation. Yet in general the frontier was largely cut off from social contact with the older settlements and hence was left free to build its own ideals and institutions in accordance with the demands of the new life and with a minimum of interference from the older civilization. (*28*: p. 95).

Under the isolated conditions of frontier life it was inevitable that much of the traditional and conventional should disappear. With no established government, or at best a far-off and vague authority, it was natural that settlers should punish wrong-doers and adjust disputes by primitive methods with scant regard for legal circumlocutions. The breaking of traditions and habits involved in migrating to the frontier encouraged relaxation of moral

standards on the part of persons not controlled by other considerations. The very primitive character of the life naturally tended to eliminate the refinements which go with leisure and with highly organized industrial society. The abundance of land almost always assured to each settler or miner as much as he could work efficiently, and thus placed all upon an equal footing economically (*46*: I, p. 16). The loneliness of the frontier made hospitality as much of an advantage to the host as to the guest. The need for mutual protection inspired group colonization and the establishment of rudimentary justice.

Explicable as these characteristics are in terms of the influence of isolation and absence of local tradition, they have about them the same flavor of intense emotion and impatience at restraints to action as was evident in the characteristics indicative of energy. Legal formalities and polite conventions that obstructed direct action were brushed aside by the pioneer in the same spirit with which he ignored danger and defied discouragement.

The individualism of the pioneer, while it had its roots in the necessity for economic self-dependence, seems to have involved also this same casting aside of restraints. To have abided by the decision of the majority, to have subordinated one's own purposes to the purposes of a group, to have accepted the dicta of social control, would have involved a hampering of activity. The qualities grouped under capacity for coöperation indicate very loose confederation, necessitating little obedience or subordination. When the advantages to be gained were sufficiently obvious and practical the pioneers would consent to mass action, yet the insistence of each man upon his own individual judgment is indicated by the lack of discipline in frontier warfare. The pioneer's hearty sympathy for his fellows has in it something of the intensity which characterized other phases of his emotional life. His ready building up of government and coöperative activity are other forms of his resourcefulness and constructive energy.

The question now arises whether the energy of the pioneer, like his lack of conventionality, might be accounted for as being due to the reaction of the frontier environment upon the settler after his arrival.

At the frontier the emotions and instincts were called directly into play oftener than in civilization. Pugnacity, constructive-

ness, curiosity, fear, and the like, came into daily requisition. Life was direct, immediate, vital, and hence intensely interesting and energy-releasing. The continual novelty of frontier experience was also undoubtedly a great source of interest and a means of releasing vitality which otherwise might have lain dormant. The thrill of primitive untrammeled existence, the stimulus of the possibility of rich rewards for effort and of the ever present sense of danger, and the compulsion to action for the sake of self-preservation, are conditions of the sort calculated to release latent psychic energy. Once started, the energetic traditions of frontier life would tend to be perpetuated by the example of others and crowd pressure and contagion. Bravery, crudeness, lawlessness and other pioneer characteristics are to a considerable degree infectious. It is hard to be cowardly among the brave, cool-headed at a camp meeting, refined in a rough and ready community, or insistent upon legal forms in a country where every man relies upon his own sense of right and ignores other regulations.

The nature of the frontier environment, with its active outdoor life was conducive to vigorous physical health, and this would presumably increase the amount of available energy.

That the molding influence of the environment is not an adequate explanation for the characteristics of the pioneer is suggested by the prevalence of tall men in the newly settled states. It will be recalled that Boas (*131*) found that children of all immigrant races studied except Italian were taller than their parents by amounts varying for the different sexes and races from .1 to 5.9 centimeters. It is possible that some similar process was at work among western migrants and that this process was due to the influences of the western environment on the race. In the absence of data to support such a guess the most probable hypothesis seems to be that selection was responsible for the difference in height between the old communities and the pioneer states.

The Selective Character of Migration to the Frontier

The inadequacy of race differences, youth, and the molding influence of the environment, as explanations for the energy of the pioneer, may best be indicated by bringing forward the evidence which proves that a more fundamental factor was operative, namely selection. The frontier doubtless served to modify the characters of those who came to it, both by helping to release their

energy and by helping to determine the channels into which the energy flowed. But the frontier acted even more fundamentally as an agent of selection. This selective power was due to three fundamental characteristics: first, the freedom which resulted from newness and thinness of population and from isolation from older centers of culture; second, the richness and free abundance of economic opportunities at the frontier; and third, the hardship and danger involved in acquiring its advantages.

Expulsive Selection

The freedom of the frontier acted in coöperation with what may be termed expulsive selection from the older societies to bring to the frontier two types, among others: the religious dissenter and the outlaw. Prominent among American settlers were the Puritans, the Scotch-Irish and the Huguenots. (*13*: p. 240; *21*: p. 140; *34*: p. 76; *38*: pp. 83-5; *40*: p. 199; *41*; *46*: I, p. 78; *51*: I, p. 102; *65*: p. 188). These groups, by virtue of their emotional intensity, their courage, their independence of tradition and their intellectual vigor found life in the old civilization intolerable and were virtually forced out into the frontier.

As France inflicted (*149*) on herself a severe loss of vital energy when she persecuted the Huguenots from her shores, so England cast out into the new world the Pilgrims, the Quakers, and all the strenuous host of those whose vigorous consciences would not brook suppression. So too the Scotch-Irish, driven, because of their religious non-conformity from their native highlands to an unfriendly home in Ulster, forged on into America and poured into the life of the new country the energy which Scotland was too rigid to receive. So also persecuted protestants from the disintegrating German Empire came, to the new world for tolerance. (*26*: p. 231-2). So too a group of Hollanders persecuted for their religion at home, came to Iowa for freedom. (*12*).

This expulsive selection did not cease when America was reached. The religious intolerance of Massachusetts forced strong-minded protesters into the wilds of Connecticut and Rhode Island. (*38*: p. 21; *21*: p. 154; *41*: p. 28). The repression of movements for political liberty in Rhode Island and New York drove the lovers of freedom westward. (*25*: pp. 7-8) The veterans of the defeat of Alamance emigrated to the Tennessee frontier rather than endure the hated oppression of the British (*2*: pp. 16-

17). Church repression on social life drove high-spirited French youths into the forests to become the *couriers du bois.* (*20*: pp. 85-6). Later, in the time of the gold fever, impatience at restraint sent many of the super-energetic of the whole country to California. (*53*: p. 274) Thus the high-potential vitality of Europe and of the east tended to be forced out into the west to build up the energetic stock which has produced the pioneer character.

Expulsive selection sent forth not only the vigorously ambitious but also the vigorously bad (*51*: I, p. 131; *23*: pp. 141, 265; *28*: pp. 72, 86 ff.). In California, Kentucky, Georgia and Michigan, on the cattle ranges and in fact on practically every frontier, appeared social parasites, outlaws, desperadoes, horse thieves, counterfeiters, professional gamblers, prostitutes (*13*: pp. 111, 204; *29*: pp. 163, 176; *33*: p. 234; *35*: pp. 690 ff; *46*: II, pp. 38, 226, 296-9; *58*: pp. 127, 141). Expulsive selection must obviously have been an important factor in sending them to the frontier, and here, among the sinners as among the saints, it was the most vigorous and intractable who were thrust out. In the former case it was conscientiousness and determination not to submit to tyranny; in the other, it was violent refusal to submit to law; in both cases the cause of the stubbornness apparently was high energy, different indeed in direction but the same in essence.

Attractive Selection

This expulsive selection of the strenuous from the old societies had its complement in the opportunities for activity offered by the new country. To the dissenters who had been oppressed and repressed by the rigidity of the old societies the new world allured with its total absence of social structure. To the ambitious and the economically oppressed the frontier beckoned with rich lands (*41*: pp. 30, 259; *23*: pp. 150, 153; *40*: p. 296; *46*: I, p. 73, II, p. 251; *49*: p. 49; *51*: I, p. 113.), plentiful game (*28*: p. 55; *40*: p. 201; *46*: II, p. 235) and fish, and above all with the opportunity to hew out a new home and achieve property (*13*: pp. 195, 245-6; *7*: pp. 48-9; *23*: pp. 144, 148-9, 147; *24*: p. 206; *38*: pp. 83-5; *40*: p. 199; *46*: p. 47; *65*: pp. 192, 197; *67*; p. 68). Sometimes there were special attractions such as gold in California and Alaska or the slavery issue in Kansas. Each channel for activity lured out its own sort of men: religious freedom attracted the intensely ethical (*21*: pp. 141-7), absence of legal restraint the lawless, danger

called out the adventurous (*28*: p. 84; *46*: I, p. 78), the slavery issue reformers, patriots, and adventurers. But in all cases it is to be noted that it was the intense, the vigorous, the virile men who were attracted. When they were good, it was an enthusiastic, intense goodness; when they were bad, they exhibited headlong, thoroughgoing, "manly wickedness." Veterans of Indian fights (*56*: pp. 67-8), of the French and Indian War (*49*: p. 49), and of the Revolution (*51*: III, p. 266; *28*: p. 93) were prominent among the pioneers at their respective periods. A group of "dangerous Puritans" from the middle class were typical of the men who responded to the lure of the frontier (*38*: pp. 83-5). Even among the indentured servants and redemptioners there were large numbers who sold their liberty only in order that they might gain the permanent freedom of the new country, and these men after their liberation often acquired property and influence (*7*: p. 48; *46*: I, p. 67).

Artificial reinforcement of the attraction of the frontier has often proved disastrous. Simple advertising when reasonably truthful seems to have brought no marked ill results (*48*: p. 36). False representations, however, lured into Ohio a party of people unfitted for frontier conditions, and left them helpless and mutinous, wholly unable to rise to the demand for pioneer energy (*40*: pp. 217-218). The benevolent attempt of Gov. Oglethorpe to bring poverty-stricken Englishmen into Georgia in the early days seems to have been partially responsible for the surfeit of lazy, shiftless and incompetent settlers in that state (*26*: p. 253). The measures taken by steamship companies in recent decades to induce European peasants to emigrate to America incurred the same danger.

On the other hand, the contrast between the "extreme individualism" of the Southwest and the intelligent collectivism of the Northwest has been ascribed (*51*: III, pp. 242, 266-7; *46*: I, p. 72) to the fact that the government coöperated in making the northwest territory attractive to the settler whose energy was of the applied variety, while the neglected Southwest attracted men of uncurbed and explosive vitality.

Whatever the influence of artificial selections, it is evident that people of the highest vital potential have been both thrust and drawn into the frontier.

Winnowing Selection

These expulsive and attractive selections acted through a winnowing gale of hardship and danger which kept the faint hearted from even venturing into the wilderness and which drove back the weaklings (*3*; *8*; *11*; *27*; *47*; *13*: pp. 240, 245; *23*: p. 149; *28*: p. 69; *34*: pp. 199, 216; *40*: p. 298; *50*: p. 835). Unhappy was the pioneer who had mistaken his calling! Faint roads led over rocks, stumps and mountains, through dense forests and icy torrents and over burning plains (*1*: p. 18; *13*: p. 197; *40*: p. 296; *46*: II. p. 220). When the frontier was reached there were often no roads at all. There were Indians (*7*: p. 53; *13*: p. 111) and wild animals to fight, bitter winters (*38*: p. 24) and long loneliness (*49*: p. 50) to live through, claims of rival settlers to withstand, privation (*14*: p. 73; *28*: p. 69; *38*: p. 24; *49*: p. 51), lack of manufactured products and of medical services, and hard toil (*49*: pp. 50-51).

The effectiveness of this winnowing process may be judged from the faint-hearted retreats which occurred from every frontier, from Plymouth onward (*38*: p. 24; *46*: II, p. 255; *51*: II, p. 386; *56*: p. 74; *59*: p. 36). The retreaters could well be spared. Unfortunately many of the brave who stayed were killed by hardship or slain by Indians (*13*: p. 111; *48*; p. 62).

The triple selection which thus brought the energetic to the frontier was not an isolated phenomenon in the world's history. James Bryce observes (*132*):

> What Europe is to Asia, what England is to the rest of Europe, what America is to England, that the Western States are to the Atlantic States, the heat and pressure of life always growing as we follow the path of the sun.

This recruiting of the far west by the near west (*3*: p. 239; *46*: I, p. 79, II, p. 196; *53*: p. 230) is vividly illustrated by the composition of the population of recently settled states in 1900, as set forth in Table 22. It will be noted that the North Central and South Central divisions between them furnished 40 percent of the populations of these states. The states themselves furnished almost 25 percent, while 17 percent were foreign born. The Atlantic states together contributed less than 10 percent. By a long process of selection there has been concentrated in the West the quintessence of the vital energy of the world.

TABLE 22

SETTLING OF THE FAR WEST BY THE MID WEST

Sources of population in states where persons native to the state formed less than 30 percent of the total population in 1900. Sources of data *122* pp. cxxvi, ff, and xcix.

State	Percentage of the population born in								
	The state of residence	North Atlantic Division	South Atlantic Division	North Central Division	South* Central Division	Western* Division	Foreign Countries	Miscel-laneous U. S.	All Localities
Average of the six states	24.4	7.7	1.9	34.0	6.1	7.6	17.3	.8	100.0
Oklahoma	15.9	2.9	3.0	51.1	21.8	.8	3.9	.6	100.0
Wyoming	21.1	9.4	2.1	35.7	3.2	9.4	18.8	.4	100.0
Washington	25.7	9.1	1.8	30.2	2.8	7.4	21.5	1.6	100.0
Montana	25.8	8.9	1.4	28.6	2.3	4.7	27.6	.8	100.0
Colorado	28.1	10.6	2.3	33.8	3.9	3.3	16.9	1.0	100.0
Idaho	29.9	5.3	1.8	24.3	2.8	20.3	15.2	.4	100.0

*Persons born in the state of residence are excluded in all cases.

13. SELECTION IN RECENT MIGRATIONS

Migration to the frontier in the settlement of the United States, as has been proven in the preceding section of this study, was highly selective in its operation, and tended to bring to the west individuals especially endowed with capacity for releasing nervous energy. In the section devoted to describing the directions and magnitudes of the migratory movements which have occurred in recent decades in the United States, it has been shown that these movements have tended increasingly toward the cities, and that the current of migration has ceased to flow into the rural districts of the middle west and is now flowing away from them. Among the statistical correlations summarized in Table 29 are several based upon quite recent data, which indicate that the interstate migrant going to western rural districts in the past few decades has had such characteristics as a low rate or illiteracy and a high death rate from homicide. The analysis of the migrations of persons listed in Who's Who for 1920-21 indicated that the migration to the cities has selected a disproportionately large number of potentially distinguished persons, or else that the cities produced distinguished persons out of migrants from rural districts. There is a strong presumption, therefore, that recent migration, like that of earlier years, is highly selective.

A Priori Analysis of Reasons for the Selectivity of Recent Migrations

The goal of recent migration is no longer a frontier in the old sense. The economic opportunities are not so rich or so free as in the pioneer days. The newer territories already have stable governments. Dangers from Indians have been eliminated, wild animals are much less dangerous than in the old days, automobiles and telephones help to reduce the isolation of thinly settled territory. The journey to the new settlement is made, not in prairie schooners, but in Pullman sleepers. The selection, therefore, must obviously be much less rigorous than that which operated in the days of the true frontier.

Selection of a very genuine sort, however, must be taking place. When a third of the youthful population leaves a settled state to make a new home farther west it is obvious that the more restless, ambitious spirits, the individuals least bound by custom and tradition, and those least inhibited by old ties and by the dread of the new and unfamiliar are the ones who migrate. Under modern conditions it is more likely that the financially successful, and the children of the financially successful, would have the free capital to undertake the journey and to purchase the land and equipment with which to begin farming in the new locality.

The migration from rural to urban districts is more distinctively characteristic of modern migration than the westward movement of rural populations. The goal of migration in this case is not a thinly settled district, but a dense center of population. The migrant is not compelled to create a new social and economic order, for he goes into a system already established and operating. Yet in a sense the city is a closer parallel to the old frontier than the western rural districts are, for the very density and hugeness of the urban centers give the rural dweller a new freedom. He goes into a life where he is not known to many of his neighbors, and where his actions are not matters of much concern to them so long as he keeps the law. Instead of the old closely knit neighborhood where everyone is intimately familiar with the personal life of everyone else and where tradition and conventionality have formed a more or less rigid matrix for the youth, the migrant to the city finds a society moving too rapidly to crystalize, and a variety of interests and points of view so broad that he is free to

choose his own manner of life and thinking. To the spirit that seeks freedom from inhibitions, therefore, the city calls with much the same promise of freedom as was offered by the old frontier.

The attractions of the city differ in superficial characteristics rather than in essential quality from the attractions of the old frontier. Instead of free land, furs, and gold to mine, the city offers cash wages, possibilities of promotion, opportunities to make a fortune. Instead of the old adventurous thrill of Indian fights, hunting, and exploring, the city lures with its multiude of stimuli, its varied and exciting amusements, its throbbing life and its spectacular events. To the potentially distinguished the city offers cultural opportunities, and stimuli and contacts with others interested in the intellectual and the artistic.

The city too has its winnowing hardships. Loneliness, meagre earnings, gruelling competition for promotion, periodic unemployment, such things as these take the place of the dangers and the hardships of the frontier.

In the case of migration to the city, therefore, it seems clear that a selection parallel to that operating on the pioneer is in force. Expulsive selection tends to force the non-conformist out of the rural neighborhood. Attractive selection lures the adventurous, restless, action-loving, energetic, potentially distinguished youth with promises of ardent life, fame and fortune. New hardships and the strenuous competition for the prizes of the city turn back the weaklings or thrust them down into the lower levels of the slums. The result to be expected is that the migration to the city takes from the rural districts the energetic stock just as the migration west-ward took from the east the energetic.

Opinions of Other Observers

This line of *a priori* reasoning has been followed by other students of the problem. Ross (*150* pp. 23-24) says:

"The city therefore drains from the country the young unencumbered adults, leaving an excess of children and aged . . . . No wonder the growing city throbs with energy and hope while the traits characteristic of the depleted country-side are deliberateness, reserve and conservatism . . . . Perhaps the trait most distinctive of those who follow the call of the distant city when farming stagnates is the spirit of initiative. They have it in them to make a start in spite of home ties, the bonds of habit and the restraints of prudence. Had they not emigrated their spirit of initiative would have shown itself along other lines . . . .

A heavy outflow of this element need not leave the community poorer in physique, or brains or character, except as these are correlated with the initiative, but it does leave it poorer in natural leaders . . . .

Of late the situation has decidedly improved . . . . so that in the more prosperous regions it is the restless rather than the ambitious who wander to the city."

Davenport's conclusions (*15*, p. 211) relative to the effects of rural-urban migration appear to have been based upon observation, though not under systematically controlled conditions:

In the rural and semi-rural population within 100 miles of our great cities we find a disproportionate number of the indolent, the alcoholic, the feebleminded and the ne'er do well . . . . Such villages, depleted of the best, tend to become cradles of degeneracy and crime. Thus our great cities lure to themselves the best of the rural protoplasm, surround it with conditions that discourage reproduction.

Many of the observers who discuss the condition of rural New England assert that the depletion is due to the trend to the cities as well as to westyard migration. Thus Deming (*77*) speaks of "the long procession of younger sons of the farm moving to the cities, or to the west;" Howard says that "the enterprising young people leave for the cities" (*83*); Sanborn (*88*), suggests that the causes of the depletion are in part the rush to the gold fields and the emigration to the prairies and to the cities, and Robinson (*85*), speaks of the exodus of young people to the cities as a most serious aspect of the problem. A different view of the causes for rural degeneracy is taken by Erville B. Woods. Speaking of "decadent rural communities such as may be found in abundance in Northern New England," he says:

A perfectly good region inhabited by perfectly good people may become discouraged, despondent, decadent, owing to nothing more serious than the inheritance of obsolete traditions of agriculture, of social relationships, and to discouragement due to long continued shrinkage of population . . . . A rural community which is given over to reminiscence and lethargy may, by a proper adjustment of its economic life and a proper stimulus of its civic imagination, begin once more to function with as much exhileration as the very immigrants and pioneers themselves. (*154*).

Further Possible Methods for Scientific Determination of Whether Recent Migration is Selective

The absence in the past of accurate statistical studies of migration suggests that the above conclusions as to the part played by urban migration in depleting New England are the results of *a*

priori reasoning and general observation rather than scientific investigation. The analysis of Who's Who statistics is not quite conclusive as to the innate superiority of the persons who migrate cityward. A broader and more direct method of determining the question would be to make accurate tests and measurements of groups of children and young people who have recently migrated to cities, and to compare the results with the results of similar tests and measurements of persons of comparable age and race in the districts from which they came. The writer has been unable to locate any material secured in this way. The nearest approach to such data is an investigation made by Collins and Pyle (*147*). The study covered the entire school population of a rural Missouri county, from eight to 18 years, including over 2,000 children. This group is compared with norms derived from tests of children in small cities chiefly in Missouri. In physical development the differences are relatively slight.

Mentally, rural children average only about 75 percent as high as urban children. The mental standing of rural children relative to urban is lowest at the age of 8 years (61 percent) and highest at 18 (89 percent). The causes for the contrast between rural and urban children in mentality are said by the authors to be better stock in the cities, tendency of urban environment to hasten mental development, and better schools in cities.

The difficulty with such comparisons between urban and rural districts is that no distinction is ordinarily made between native-born and foreign-born, and that the migrant stocks are not differentiated from the non-migrant. The result is that it is impossible to say whether an observed difference is due to a contrast between migrants and non-migrants or whether it arises from some other difference between the urban and rural groups considered. This difficulty in addition to other defects, prevents the use of data as to the relative physique of army draftees from urban as compared with rural districts, and the data as to physical defects in city and country school children.

In spite of the absence of field studies directly focused on the problem, the conclusion that migration from rural districts has been selective is so strongly supported by statistical data, by *a priori* case in favor of such a view, and by the weight of opinion in its favor, that it seems justifiably to accept the conclusion, and

to act upon the hypothesis that the rural exodus is draining territories such as the country districts of Iowa of highly energetic and able individuals, leaving individuals of lower energy and ability to be the parents of the children of the future.

14. THE INFLUENCE OF MIGRATORY SELECTION ON CHILD WELFARE

Two questions must be answered in determining the relationship of the migrations of the past to the welfare of the children of the future. The first is: to what extent are the characteristics of the pioneer and recent migrants likely to be transmitted to coming generations? The second is: to what extent are pioneer and recent migratory characteristics desirable in parents and children?

The Inheritance of Energetic Characteristics

Relative to the hereditary transmission of the characteristic of being energetic, Davenport states:

> Of the inheritance of this quality (general bodily energy) there can be no doubt . . . . when both parents have bodily energy that is regarded as 'decidedly above the average' all of their children will have either excetpional or at least medium energy. The mating of two energetic parents in 192 families produced 413 offspring . . . . Of these 301 (73 percent) are placed in the highest grade. (15 pp. 63-4).

The method used by Davenport in arriving at the above conclusion was the rating of a group of parents according to their general bodily energy and the similar rating of their children, with a comparison of the results. The same method may be applied in a more wholesale way by comparing the ratings of the pioneers as analyzed in earlier sections of this dissertation with the ratings of the American people of today by detached observers. The ''American people'' referred to in these ratings are presumably the classes with whom the average better-class traveler comes in contact, and this class is in general made up of the descendants of the pioneers who settled the United States, with an admixture of recent immigrants and their children. If the characteristics observed of the Americans of the present correspond closely with the characteristics observed of the pioneers, the conclusion is strongly suggested that the pioneer characteristics tend to be transmitted, either through the germ plasm or through the influence which passing generations exert upon the environment of coming generations. The writers selected are chiefly foreign

observers of various nationalities who have published comments upon American characteristics within the past ten years.

Gustav Rodrigues, a French observer, entitled his book on the Americans, *The People of Action.* Its conclusions are thus summed up by J. Mark Baldwin:

What is the American? This is what he is: In temperament a man of action, of efficiency; in the matter of culture, a novice; in theory and practice—so far as he has any—an individualist; in tendency and purpose, whether individual or national, an unconscious idealist. (*97*: p. xxiii).

"On all these points," remarks Baldwin, "I agree with the author." Some of the phrases used by Rodrigues to describe the American are:

Largeness of conception, rapidity of decision, and—in a word—audacity of execution (p. 28) . . . . for his sole purpose is to tend to put forth all his strength indefinitely, unceasingly. (p. 37). Most individualistic (p. 38). His true joy is to live intensely rather than deeply (p. 38). This ardor in the pursuit of wealth does not exclude generosity (p. 48). With the American the instinct for freedom of movement . . . . is characterized by impetuosity, violence (p. 56). He is not cultivated, but rough hewn, a vivid, cheerful creature (p. 57), a tenacious man (p. 58).

Hugo Münsterberg (*96*) uses the following expressions as descriptive of the Americans:

Yearning of the American heart after self-direction. Inborn good nature (p. 3). Complete individualism (p. 7). Instinct for free self-initiative . . . . pressure to be up and doing (p. 229). The American chases after money with all his heart . . . . and it is the game he likes and not the prize (p. 234). The American takes the keenest delight in the employment of all his faculties in his work and in the exercise of his own initiative (p. 235). The tireless instinct for personal perfection (p. 362).

George T. Smart (*99*: p. 137) says:

The American works faster than the European. The American not only works faster; he walks faster,—everything he does is done more fiercely.

George Santayana says of the American (*98*):

All his life he jumps into the train after it has started, and jumps out before it has stopped, and never once gets left behind or breaks a leg (p. 592).

The discovery of the new world exercised a sort of selection among the inhabitants of Europe . . . . The fortunate, the deeply rooted and the lazy remained at home . . . . The American is accordingly the most adventurous, or the descendant of the most adventurous of Europeans (p. 590).

H. K. Tong, managing editor of the Peking Daily News says (*100*):

> America's hustling enterprise is matchless . . . . Although China cannot equal America in commerce, transportation, daily luxuries and education, on the other hand, Chinese hospitality, filial piety, cheerful industry, politeness, wonderful memory, and peace-loving temperament are lacking in Americans. . . . In industry the Chinese excel the Americans . . . . The Chinese people are always content with their lot; the Americans never are.

Sudhindra Bose, a Hindu student in this country, used the following expressions in writing of the American character (*94*):

> Incurable optimism . . . . ultra independence . . . . intelligent, keen and alert . . . . none too industrious . . . . not thorough . . . . diversity of interests . . . . superficiality and inaccuracy . . . . in point of capacity and natural ability the American ranks with the Hindu; in originality and energy the American is superior; but in application and thoroughness inferior. . . . frequently regarded as uncompromising individualist, self-complacent, self-sufficient.

Edward A. Steiner says (*99.1*):

> We are wasteful, extravagant and reckless.

Gertrude Kingston, a British observer, uses such expressions as the following (*95*: p. 259):

> Bouyant quality of young America's hopefulness . . . . Optimism is the prevailing note of the poor . . . . The American youth . . . . is full of self confidence . . . . Though the other man may not like being worsted in the fight, it appears to act rather as a spur to him than as a discouragement . . . . No American ever gives up hope of becoming a millionaire.

An exceptional opinion is that expressed by Henry Nevinson of England:

> In my own experience, limited to the Eastern and Central States, but varied and including most classes, I found the American exactly opposite to his reputation among ourselves. He is thought to be ill-mannered, discourteous, brazenly boastful, grasping, oversharp in business, free, inclined to change, rebellious, and fearless of the future. I found him exquisitely polite, obliging almost to excess, so modest that he accepted as evangelists lecturers who in England would be received with mockery, so careless of business that he does not persuade his innumerable "stenographers" even to answer a letter, and so far from liberty-loving or rebellious that he allows himself without protest to be ruled by second-rate men and by a police system almost as vile as the Russian or German before the revolutions. Grace and charm are the dominant characteristics. (*96.1*)

This divergent opinion possibly reflects a development of the eastern character as a result of westward migration.

These detached observers of the American people of to-day mention as salient characteristics the very qualities which distinguished the pioneer. Executive intensity—love of action for its own sake—is the feature most prominent in the modern American as it was in the frontiersmen. Emotional intensity—optimism, buoyancy, ardor, vividness—these characteristics stand out to-day as they did on the frontier. Mental vigor—hunger for self-perfection, keenness, alertness—still distinguish the American. Inhibitions still are disregarded; wastefulness, recklessness, tenacity, absence of culture, individualism and democracy are prominent among the features noted by foreign observers.

Certain qualities of interstate migrants as shown by the correlation method are also distinguishing characteristics of the American People as a whole, though in a less intense degree. This is especially true of murder and divorce. Frederick L. Hoffman is quoted as authority for the statement that the rate of homicide in this country was 6.5 per 100,000 in 1911 as compared with .9 in England and Wales. (*107*). The United States Census Report on Marriage and Divorce for the period 1867-1906 states:

> The divorce rate is higher in the United States than in any foreign country except Japan. Switzerland, which has the highest rate of any European country, reported 32 divorces per 100,000, only about three-sevenths the number reported in the United States. (*126*)

In general it is clear that the characteristics which distinguish the interstate migrant are intensifications of the characteristics which distinguish the American from Europeans, and conversely that the American character has been determined to a considerable extent by the inheritance of pioneer characteristics.

The pioneer character has persisted. Social momentum certainly has played its part in the perpetuation of the traits of early settlers, but in view of the revolutionary change in the environment with the passing of the frontier, the persistence of the energy of the frontiersmen must certainly have been due in large part to its hereditary transmission in the germ plasm.

Significance of the Fecundity of the Pioneers

Since the pioneers tended to hand on to their children, both through the germ plasm which they transmitted and by the traditions and institutions which they formed in their families and in their communities, their energetic characteristics, the fact that the pioneers were prolific becomes especially important. Select-

ive migration would have relatively little influence upon the welfare of children in the world as a whole if migrants had the same tendency to reproduce as non-migrants. Actually, however, the early migrations to the west were correlated with very high fertility, and the characteristics of the pioneers therefore were transmitted, socially and biologically, to a disproportionately large fraction of succeeding generations. Conversely, the fact that recent migrations are inversely correlated with fecundity indicates that the characteristics of modern migrants are less likely to be perpetuated by inheritance than those of non-migrants.

Pioneer Characteristics in Relation to Desirability in a Parent

In order to discuss whether or not it is desirable that the energy of the pioneer and the other characteristics which grew out of this energy should be widspread among the parents of American children it is essential to define what is meant by desirability in a parent. The desirable parent is the sort of parent who best promotes the welfare of the child. By child welfare as used in this study is meant the conditions which promote first the happiness of the child during childhood, second the future usefulness of the child to society, third the development in the child of the capacity for happiness in later life, and fourth the capacity of the child during childhood to contribute to the happiness of others. Parents who best contribute to these four aspects of child welfare must, first, be the bearers of germ plasm which is not only free from degeneracy, but which is capable of developing for the child an organism fitted for service and for richness of experience. Desirable parents must in addition be able to maintain a normal economic environment for the child, must have a moral character such as will develop in their offspring ethical idealism, and should have intelligence such as will promote the intellectual life of their children.

Child Welfare in Rural New England

The significance of pioneer energy in relation to desirable parenthood is brought out strikingly by contrasting conditions in rural New England with conditions among the frontier settlers, and by considering the relative advantages to a child of being born of pioneer stock rather than of residual New England stock, and of being born in the environment provided by the pioneers rather

than in the environment provided by the residual New Englanders. Conditions in rural New England in recent years may be brought out by quotations from various observers.

Lincoln Steffens wrote of *Darkest New England* as follows (*90*):

In two states, Connecticut and Vermont, there is all the appearance of political and social death. . . . There is little vitality of any sort. There is degeneracy; not only political, moral and mental, but physical. Statistics show insanity, and direct inquiry shows most abnormal sex decadence.

Steffens asserts that the ''good old American stock in the country and in small towns'' is ''regularly for sale'' in elections, and that the practice is so well-established that it has corrupted the very thinking of the communities.

C. Deming writes (*77*) of the

decline of old yeoman pride; decay of local spirit and habit of association; lowered interest in politics and civic matters.

The Rev. H. A. M. Briggs (*73*) writes of a rural Massachusetts community:

Rural communities are languishing for the best things of religious social economic and industrial life. . . . The people are not prepared to take the initiative. . . . Evidences of this decline (of sturdy New England families) are apparent in every rural community. . . . A better rural race is needed; rural sections demand new blood, sturdier life. The New Englander cannot provide enough of it.

Alvin F. Sanborn (*88*) uses the following expressions in writing of *The Future of Rural New England*:

The men are listless, sullen and stolid. . . . The women pale, haggard, prematurely old, shrill, ill-tempered, untidy, and inefficient in housekeeping. . . . The social life is pinched and bare. . . . Of neighborliness there is little. . . . A dearth of public spirit. . . . Civic honesty naturally is at the same low ebb as civic spirit. . . . Its outward delapidation and emptiness of inner life could not be exaggerated.

R. L. Hartt, writing of *Rural Regeneration of New England,* says (*81*: pp. 506 ff.):

And the misfortune........is not a mere reduction in quantity. It is also reduction in quality. The ambitious, energetic, progressive element departs; the stolid, enfeebled, immobile element remains........ The inhabitants are sunk to hideous degradation........awful dry-rot that is taking the life out of the country towns.

C. N. Hall (*79*: p. 54) says:

From these (hill) towns the young blood of the Yankee race has long since departed to more promising fields of effort.

Tre Rev. Julius H. Ward, in discussing *The Revival of our Country Towns,* says (*92*: pp. 242-243):

. . . . there are left for the distant country towns among the hills chiefly the lame and the lazy and those who either take to the soil or have duties to others which compel them to remain. . . . The vital element, the social and personal lead in the rural town has been taken away.

Frank W. Rollins says, in relation to *The Renaissance of New England* (*86*):

(The loss of population by the country towns has been) attended by the loss of the brightest, best and most energetic youth. The Town loses its ability to keep up schools, religious interest, civic and moral tone, loses energy and hope. Those left are the aged, decrepit, feeble and non-ambitious.

Gill and Pinchot, in their study of 6000 country churches describe as follows the social conditions in 18 predominantly rural counties in southern and southeasern Ohio: (*25.1*)

The religious, social and economic welfare of the people are going down. . . . The churches have failed and are failing to dispel ignorance and superstition, to prevent the increase of vice, the spread of disease, and the general moral and spiritual decadence of the people. . . . In this region, therefore, where there is so high a percentage of illiteracy, of illegitimacy, and of deaths from preventable disease, the people are more nearly pure Americans than in the rest of the State. . . . Here gross superstition exercises strong control over the thought and action of a large proportion of the people. Syphilitic and other venereal diseases are common and increasing over whole counties, while in some communities nearly every family is afflicted with inherited or infectious diseases. Many cases of incest are known, inbreeding is rife. Imbeciles, feebleminded and delinquents are numerous, politics is corrupt, the selling of votes is common, petty crimes abound, the schools have been badly managed and poorly attended. . . . Moral and religious poverty must bear at least as much of the blame as poverty of soil. . . . As a rule the agricultural opportunities of the region are neglected. . . . Poor soil, as a rule, does not hold upon itself the most enterprising families so tenaciously as good soil, and for that reason we might fairly expect the people of these districts to have less vigor and less initiative . . . . It is calculated that no less than 61,000 persons emigrated in the 10 year period from 1900 to 1910 from the strictly rural districts of 16 of the 18 counties.

The rural conditions pictured by these writers hardly constitute the sort of environment into which a child could be born with the brightest prospects of happiness and of service to its fellow men. Decayed in its government, schools and churches, broken down in its morals, bankrupt in spirit, a community such as this would tend to be the grave of ambition and of achievement. Nor are the natives who have allowed their community to sink to such levels desirable as parents. Flaccid, ennervated, stolid, bitter against re-

form, degraded in morals, these culls of the American stock promise to their children degenerate germ plasm and poverty, both economic and spiritual.

The Feebly Motivated

Discussions of race betterment have concerned themselves chiefly with means of eliminating the feeble-minded and if possible encouraging the reproduction of the powerful-minded. It has been claimed that vice, pauperism and crime are closely associated with feeble-mindedness, and that these problems can never be solved as long as imbeciles and morons go on reproducing at rapid rates. The facts presented above indicate that no less important than feeble-mindedness is feeble-motivation and that no less important than powerful-mindedness is powerful-motivation. In the conquest of poverty, with its resultant sickness, mortality, neglect and misery not only the inability to understand but the inability to act with energy must be eliminated. It is not so much lack of intelligence that stands out in the mind of the average social worker in considering the causes for the failure of the families who become dependent upon charity; as far as the causes are individual rather than social, it is shiftlessness, laziness, lack of energy, that characterize the poor. Recent studies of the earnings of morons indicate that many feeble-minded people are earning fairly high wages. The army mental tests showed that many a day laborer has an intelligence quotient equal to that of the average skilled worker, while many a clerk has an intelligence quotient equal to that of the average professional or business man (*157.3*). It may be found that one reason for this imperfect correlation between mentality and success in life is that a high endowment with energy-capacity may carry a man to success in spite of inferior intelligence, while superior intelligence is of little value without the energy, initiative and persistence to apply it.

It is clear then that child welfare would not be promoted by a radical reduction in the energy of the parent stock. The other extreme may be illustrated by the pioneers of the pioneers—the wilderness breakers.

Child Welfare and the Ultra-Frontier

The energy of the pioneer in itself, however, is not necessarily associated with desirability for parenthood. This fact is emphasized by the contrast which appears at a number of points between the

three groups of pioneers—the wilderness breakers, the cabin builders and the settlers. The contrast is highly significant, for the settlers were by far the most numerous group, and the most likely to leave offspring. The wilderness breakers were apparently more extreme and unregulated in their characteristics than the other groups. Their bravery was very likely to take the form of rashness and recknessness. The references to vice and dissipation refer chiefly to this group. The cabin builders were distinguished for their restlessness. They are noted especially for their emotionalism of the wilder and sterner type, for their physical health, bravery, and recklessness, and not so much for enterprise, tenacity and kindly emotions. The settlers stand out from these other two groups as characterized especially by constructive energy—ambition, industriousness, determination and initiative. They are noted for sympathy and hospitality, for their self-sufficiency and their democracy. The emotional excitement which took the forms of enthusiasm, ardor, passion, vice and wildness in the earlier pioneers appeared mainly as religious emotionalism and sternness in the settler. The settlers were notably brave, yet recklessness, carelessness of the future, extravagance, and waste are rarely asserted of them and even frugality and thrift are mentioned among their characteristics.

These fundamental differences between the types probably indicated an actual difference in vital potential. The extremely energetic naturally forged to the front in the conquest of the wilderness, and cast off restraints most completely. Yet aside from such differences in energy endowment the divergence seems to have been a result of the presence in the settler of certain directive circumstances, habits, ideals and traditions which were absent among the wilderness breakers. First, the settlers were most of them married, whereas the explorers, scouts, miners, cowboys and trappers who composed the wilderness-breaker group almost invariably either were unmarried or were separated from their families. Hence the former type had always before them the necessity of providing for and protecting a wife and usually a large family, while for the wilderness-breakers that responsibility was either wholly absent or was so far off as to exert but a faint influence upon action. A second factor was found in the traditions of character and self control which were potent in the settlers

but which for several reasons were usually absent in the wilderness-breakers. Their presence in the settlers was due to the dominance among them of New Englanders and of the Scotch-Irish and other groups whose original migrations were religiously motivated. The ideals of the old New England were perpetuated by the tendency of New Englanders to emigrate in groups and to carry with them the church, school and town meeting. Even though the forms tended to drop away with each successive generation, the larger view of things, the essentially ethical reaction toward life gave a direction to the activity of the settlers which persisted until the recrystalization of society established these traditions in a conserving social fabric. The wilderness-breakers were carried by their excessive and restless energy farther from the influence of responsibilities, traditions and regulations.

It should be noted, however, that the restrictions tolerated by the settlers were primarily directive rather than obstructive. While the miners were toiling fiercely for gold and spending it recklessly in excitement, and while the cabin builders were plunging restlessly on into the wilderness, the settlers were bending their energy to clearing and improvement of land, the raising of crops and the accumulation of property. For the wilderness breaker any momentary excuse for activity was sufficient to call forth his energy; but the responsibilities and traditions of the settler directed his vitality along channels where it would serve his higher ideals.

The Advantages and Dangers of Pioneer Energy

Three contrasted groups have thus been presented: first, the residual New Englanders left behind by the pioneers; second, the wilderness-breakers and cabin builders who forged ahead in the migration; and third, the settlers who formed the great body of the pioneers. The first group clearly lacks elements essential in desirable parents. Both its deficiency of innate energy, and the decadence of its institutions renders this un-pioneer stock unfit to be the parents of the finer type of children. The second group, while it displayed an entirely adequate endowment of energy-capacity, lacked the directive traditions and ideals necessary to turn its activity into safe and useful channels.

The third group, made up of the pioneers proper, combined high capacity for energetic action and emotion with idealism and

social traditions such as tended to direct its energy into productive activity. It must be recognized that even in this group undesirable characteristics appear. The high rates of homicide and divorce in recently settled states, and the tendency to litigation are adverse counts in estimating the value of pioneer characteristics from the standoint of child welfare. On the other hand ambition, warmth of emotional life, absence of illiteracy, high percentages of school attendance, resourcefulness, courage, readiness to respond to a national emergency, tenacity, genuineness, and capacity for coöperation are qualities of first importance in estimating the desirability of parent stock. The children of the future need all of the pioneer energy that can be given them. With it their welfare demands the development of safeguards against the dangers into which unregulated energy is likely to lead.

15. SUMMARY OF CONCLUSIONS FROM CHAPTER III

1. Statistical correlations indicate that interstate migrants in 1830 were characterized by high fecundity, but that the reverse was true in 1910, that westerners in the sixties tended to be tall, and ready to furnish Civil War recruits, that interstate migrants to rural districts have had high divorce, homicide and school attendance rates, with low illiteracy rates, that native migrants have included large quotas of lawyers and journalists, that the frontier states produced relatively few distinguished persons while cities have both attracted and produced large number of the potentially distinguished.

2. Observers report that the pioneers were characterized by executive and emotional intensity, by mental and physical vigor, by courage, recklessness, tenacity, defiance of legal, social and moral formalities, by self-reliance and by capacity for coöperation.

3. Residual rural New Englanders are widely reported as lacking most of the characteristics listed in the preceding paragraph.

4. The basis of the pioneer character was a high endowment of nervous energy, acting in an environment where traditions, conventions, and legal and economic restraints were largely absent.

5. Innate differences between persons in their nervous energy might be explained in ways consistent with the best psychological thinking.

6. The fundamental cause for the high energy of the pioneer was the action of expulsive, attractive and winnowing selection in the migratory process.

7. Recent interstate and rural-urban migrations have also apparently tended strongly to select the energetic and intelligent.

8. The characteristic of being energetic tends to be transmitted by heredity.

9. The character of the American people as a whole is strikingly parallel to that of the pioneer.

10. The type of individual left behind in interstate migrations, and the extreme type of ultra-pioneer, were neither of them as desirable as parents as were the pioneer settlers.

11. The welfare of the coming generation can best be promoted by a greater endowment of energy under better control.

IV. SELECTIVE MIGRATION IN IOWA

In 1850 Iowa was on the frontier and was being settled by the pioneers whose characteristics have been discussed in previous chapters. In 1910 Iowa was reported as the only state in the United States which had lost population during the preceding ten years. The analysis of interdivisional migration (see page 36) showed that the West North Central States, of which Iowa is one, have been among the heaviest losers in recent decades through rural emigration. Iowa, therefore, is a particularly appropriate state to study for details as to the operation and the effects of the recent type of migration. The fact that Iowa has a state census at dates midway between the dates of the federal censuses facilitates such an inquiry.

16. THE MEASUREMENT OF RECENT MIGRATIONS IN IOWA

The application to Iowa data of the age-distribution method of measuring migrations involves certain special problems. The first of these is due to the fact that Iowa is not a part of the Registration Area, and does not have complete registration of deaths. This makes necessary the estimation of survival rates by methods less direct and accurate than those used for the United States as a whole. The second problem lies in the use of state census data in conjunction with federal census reports for the state, so as to reduce the intercensal periods to five instead of ten years. The state censuses report age distribution according to different age groupings than those used by the federal census, so that extensive interpolations must be made. Also the question arises whether the state censuses are of the same degree of accuracy as the federal censuses. These special problems will be discussed in detail in the next few pages.

Death Rates

The incompleteness of the death reports published for Iowa by the state authorities is presumable in view of the fact that the government has not admitted the state to the registration area; but the number of deaths reported may be used as a lower limit, above

which the true number of deaths must lie. Moreover since the variations in the death rates from one community to another are determined chiefly by the age and color distributions of the respective populations and the proportions of the respective populations living in cities, it is possible to make fairly accurate estimates of the deaths by ages in Iowa by weighting according to Iowa conditions the death rates by ages in the cities and the rural districts of the registration area in 1910. No correction for chronological changes has been attempted. In as much as Iowa is a state where the high economic level of the population insures a relatively low death rate, the estimate based on conditions in the registration area may safely be taken as a maximum rate for the state. A third factor which reduces the error from incorrect death rates is the fact that the death rates are lowest at the ages in which migration is most frequent. The force of these three factors is more readily appreciated by examining Table 23 and Chart 8 in

TABLE 23

IOWA DEATH RATES

per 1000 by ages, as calculated from state reports for 1915 and as estimated from rural and urban death rates in the original registration states in 1910. Based on data from *106*; *111*: pp. xix, lxxiv. See also *151*.

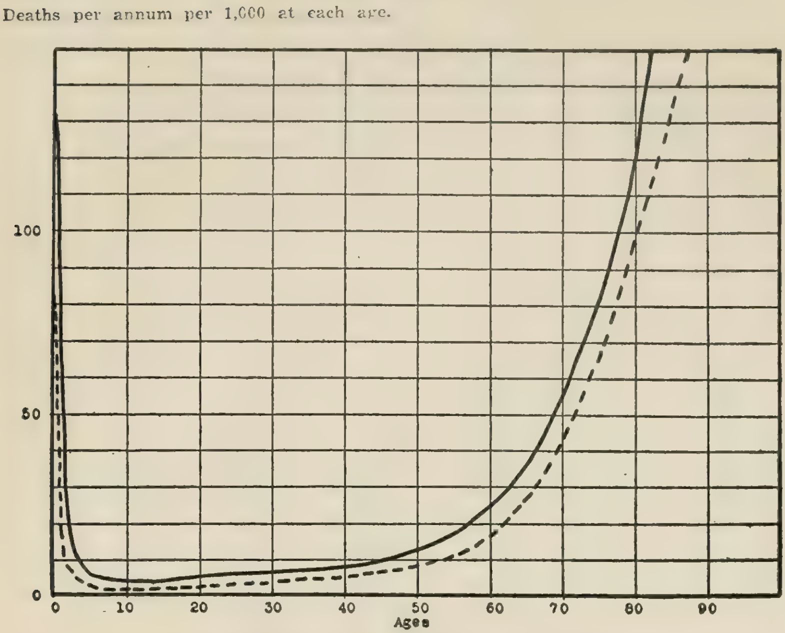
	Ages						
	0-1	1-5	5-10	10-20	20-30	30-40	40-50
State reports	56.1	4.6	1.5	1.7	3.2	4.3	6.4
Registration area	108.4	11.0	2.9	2.9	5.3	6.7	9.4
	50-60	60-70	70-80	80-90	90-	All ages	
State reports	11.5	26.7	66.6	132.7	192.2	9.5	
Registration area	18.1	36.2	82.0	174.9	334.9	14.5*	

*Weighted according to age distribution of Iowa population.

which the death rates by ages in Iowa in 1915, as estimated from state reports, are compared with the death rates by ages estimated by weighting the death rates by ages in the original registration states for males and females in cities and in rural districts according to the importance of corresponding groups in Iowa.

The effect of this difference in estimated death rates upon the estimate of migration may be illustrated by taking the period of life in which migration is most frequent—10 to 30 years of age. In 1900 there were 864,627 persons of these ages returned for Iowa by the federal census (*125* p. 374). If the death rates estimated from the registration area were operative in the state,

CHART 8



IOWA DEATH RATES BY AGES.

as calculated from data reported for 1915 by state officials and as estimated from death rates for rural and urban districts of the original registration states in 1910. (See Table 23.)

approximately 822,500 of these persons would survive in 1910 (at which time their ages would of course, range from 20 to 40 years). The 1910 census returned only 703,043 persons 20 to 40 years of age in Iowa. (*125* p. 374) This would leave 822,500—703,043, or approximately 119,500 persons who presumably must have left the state during the years 1900 to 1910 in excess of the number of these ages who entered the state during the same period. This would amount to a net emigration of 14.5 percent of the survivors. If on the other hand the state reports were correct, and the low death rates which they show were actually in operation the result would indicate that 837,500 persons survived instead of the 822,500 indicated by the registration area rates. The net emigration in this case would be approximately 134,500 instead of 119,500, or 16.1 percent instead of 14.5 percent of the survivors. These estimates, as indicated above, may be assumed to be the upper and lower limits between which the correct number lies.

The probable percentage of error in estimates of emigration for the older age groups would tend to be larger, though the absolute error in number of emigrants would be much smaller. Of all persons five years of age or over in the state in 1900, the net emigration during the decade 1900-1910 was 232,600 if the registration area death rates are used, and 282,500 if the state report rates are used. If, therefore, the only source of error were the death rates, we might say with considerable finality that between 230,000 and 280,000 persons left the state in excess of those entering it between 1900 and 1910.

State vs. Federal Census Totals

Two other sources of error must, however, be examined. The first of these is suggested by the contention of the state census authorities that the 1900 census returns for Iowa were 100,000 too large and the 1910 returns 75,000 too small. (*111*: p. xviii). This contention is made, as the report states, "without any pretense of information on which to base the assumption." The object avowed is to secure an estimate of population increase "more in harmony with known facts" and to show a steady increase in population instead of irregular gains and losses from 1900 to 1915.

If these assumptions of the state authorities were correct, the amount of emigration from the state during the decade 1900-1910 would be less than half the estimate given above, while the migration between 1910 and 1915, instead of being a gain of 8,000 would be a loss of 80,000 or so. The best test as to accuracy of the federal and state census returns would be a comparison with independent sources of information. Probably the most satisfactory

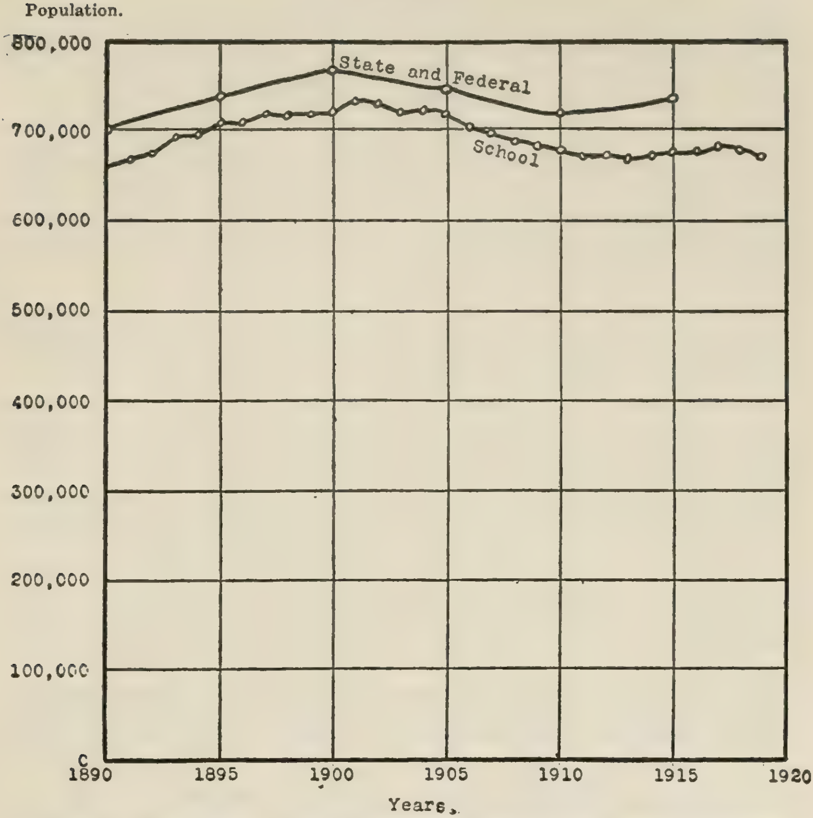
TABLE 24

Federal, State and School Census Returns Compared

Number of persons five to 20 years of age in Iowa as reported by the school, state and federal census, 1890-1919. Sources of data *110*: p. xi; *109*; *111*: p. lvix; *121*: p. 215: *125*: p. 374: *112*.

Year	State and federal returns	School Enumeration	Ratio
1890	701,182	660,495	106.2
1895	736,808	712,941	103.3
1900	767,870	731,154	105.0
1905	749,512	716,882	104.5
1910	721,392	677,004	106.6
1915	736,925	678,192	108.7
1919		674,369	

CHART 9



STATE, FEDERAL AND SCHOOL CENSUSES COMPARED.
Iowa population five to 20 years of age inclusive, as reported by school ennumerations, and as returned by the state and federal censuses, 1890-1919. Sources of data same as for Table 24.

auxilliary index of population is the school census, under which enumerations are made every year of the number of persons five to 20 years of age inclusive. A comparison of the school census with the state and federal returns for the same age period is given in Table 24. Chart 9 shows the comparison, with the intervening years of school census recorded.

These data corroborate the general trend of the state and federal census. Both sources of information agree that the population of the ages stated increased from 1890 to 1900, that it was lower in 1905 than in 1900, and still lower in 1910. They both indicate an

arrest of the downward trend before 1915. This close correspondence between entirely independent sources of information removes all ground for the guess on the part of the state census authorities that the federal census for 1900 overstated and for 1910 understated the true population. The probability seems strong that both state and federal censuses are close approximations to the truth. If any presumption of inaccuracy is created by the comparison, it is that the 1915 state census was relatively more complete than those preceding.

Age Distribution

A third source from which error might enter into the method herein used for estimating migration, is the possibility that the age distribution of the population may be incorrectly returned by the state or federal censuses. This error might be of two types: either a constant tendency on the part of one census after another to understate or overstate the number of persons in a given age group, or a tendency to variation now in one age group, now in another. The first source of error may be operative in the early years of life as suggested earlier in this study (page 21.) The effect of an understatement of the number of persons under five years of age, would be to produce at the census five years later the effect of an ingress of persons five to nine years of age, since a large number of children missed as babies would be enumerated at later censuses. This possible source of error is aggravated in the Iowa data by the fact that the 1905 state census reports an unusually small number of infants. The fecundity indices for the last four censuses show a marked slump in 1905 which is difficult to account for. As shown in Table 25 the decrease in the index was .135 in the fifteen years 1900-1915, or .009 per year. From 1900 to 1910 it was .086

TABLE 25

Fluctuations in Reported Proportions of Children

Fecundity indices derived from state and federal censuses of Iowa 1900-1915; Sources of data *111*: p. lvix; *123*: p. 38; *125*: p. 374.

Census	Children under 5 years of age	Women aged 21-44	Fecundity Indices Col. 2 ÷ Col. 3
1.	2.	3.	4.
1900 (federal)	263,422	372,021	.706
1905 (state)	233,843	380,720	.613
1910 (federal)	236,063	380,907	.620
1915 (state)	237,760	415,984	.571

or .0086 per year. From 1900 to 1905 the decrease reported was .093 or .0186 per year—more than twice the normal rate. If the decrease in fecundity was really gradual, the number of children reported under five years should have been 252,000 or 18,000 greater than the number shown by the 1905 census.

In order to obviate this possible source of error, for which no accurate corrective is available, the migration of persons under

Habitual errors in other age groupings may occur. The tendency to concentration on years ending in zero may increase the number of persons reported in certain age groups. This, however, would tend to produce excess and deficiency alternately in the estimated number of migrants in successive five year periods. No such tendency appears in the actual results.

Hap-hazard errors in age groupings would be subject to discovery by comparing the estimates of migration for the period 1900-1905, with estimates for 1905 to 1910 and 1910 to 1915. No important error is apparent from such comparisons. The chance of such error is increased by the fact that the state census makes its returns in irregular age groupings—under five years, five to 10 years, 10 to 18, 18 to 21, 21 to 45, and 45 and over. As a result it has been necessary to interpolate by graphic methods in order to secure age groupings comparable with those of the Federal Census.

To summarize the matter of error in the age distribution method as applied to Iowa data, it may be said that the use of weighted registration area death rates in the absence of reliable Iowa death rates means that the estimate of the total net number of persons leaving the state of Iowa may be as much as ten percent too low,

TABLE 26

Age Distribution of the Population of Iowa

by sexes, arranged according to the groupings of the state census, according to federal and state returns, 1900-1915. Sources of data *110* p. xl with corrections based on pp. 2-382; *111* p. lvix; *125* p. 374.

Sex and dates	Ages							
	All ages	0-5	5-10	10-18	18-21	21-45	45-	Unknown
Males								
1900	1,156,849	133,621	129,316	192,440	66,174	409,586	222,359	3,353
1905	1,132,251	118,877	122,521	188,436	66,209	394,638	241,570	.....
1910	1,148,171	119,591	115,852	179,825	69,231	406,598	254,544	2,530
1915	1,212,988	120,958	121,914	180,950	69,032	440,389	279,745	.....
Females								
1900	1,075,004	129,801	127,326	186,684	65,930	372,021	191,374	1,868
1905	1,077,815	114,966	119,843	184,873	67,630	380,261	210,242	.....
1910	1,076,600	116,472	112,570	176,188	67,726	379,682	222,741	1,221
1915	1,145,078	116,802	118,865	176,431	69,733	415,984	247,263	.....

TABLE 27

IOWA NET MIGRATION

Estimated net migration into or out of (—) Iowa by age periods during the pentads 1900-1905, 1905-1910 and 1910-1915. Sources of data *106*; and Table 26.

Ages at beginnings of pentads	1900-1915			1900-1905		1905-1910		1910-1915	
	Both sexes	Males	Females	Males	Females	Males	Females	Males	Females
Five and over	—224,900	—107,500	—117,400	—74,450	—55,600	—38,700	—64,200	5,650	2,400
5-9	—39,600	—19,200	—20,400	—8,200	—10,000	—8,700	—8,300	—2,300	—2,100
10-14	—8,000	—6,700	—1,300	—6,800	—2,200	—4,100	—3,700	4,200	4,600
15-19	—21,500	—11,900	—9,600	—8,000	—4,800	—2,700	—8,600	—1,200	3,800
20-24	—50,100	—23,600	—26,500	—11,800	—10,700	—6,900	—13,600	—4,900	—2,200
25-29	—40,650	—19,750	—20,900	—12,250	—9,600	—7,800	—10,700	300	—600
30-34	—15,700	—6,900	—8,800	—10,400	—5,000	—1,100	—4,400	4,600	600
35-39	—19,350	—8,700	—10,650	—7,900	—4,150	—2,700	—5,100	1,900	—1,400
40-44	—10,100	700	—10,800	—4,100	—5,300	300	—4,500	4,500	—1,000
45-49	—6,500	—3,500	—3,000	—2,800	—1,400	—800	—1,000	100	—600
50-54	—19,850	—10,850	—9,000	—2,050	—2,400	—5,100	—4,200	—3,700	—2,400
55-59	—3,550	—2,600	—950	—800	—1,950	—2,100	—700	300	1,700
60-64	950	1,050	—100	550	—250	—400	0	900	150
65-74	5,350	3,050	2,300	1,300	1,300	700	300	1,050	700
75-84	8,000	3,700	4,300	1,600	2,350	400	—100	1,700	2,050
85-	200	600	—400	300	200	—200	—800	500	200
Unknown	—4,500	—2,900	—1,600	—3,100	1,700	2,500	1,200	—2,300	—1,100

but is probably much more nearly correct than that; that there may have been a slight fluctuation in the completeness of the census returns, involving particularly a deficiency in the 1905 census as compared with 1915, which would have the effect of understating somewhat the actual amount of emigration between 1905 and 1915, and finally that the age distribution is not probably the source of serious error except in the earliest age group, which has been omitted for that reason. The effect of the method used, therefore, is to understate the amount of emigration from Iowa, especially in recent years.

17. ESTIMATED AMOUNTS OF EMIGRATION AND IMMIGRATION

The results of the application to Iowa in recent pentads of the above-described method of estimating migration are given in Table 27.

Foreign-Born Migration

Table 27, it should be noted gives a summary picture of the net movement of the population as a whole. Closer study of the data reveals the fact that there have been subcurrents flowing often in directions opposite to that of the main stream. The state census reports (*111*: p. 468) that in 1915 there were 29,883 persons in Iowa who had been in the United States less than five years, and that there were in addition 25,002 persons who had lived in the United States between five and 10 years—a total of 54,885 persons who must have entered the state between 1905 and 1915. From another angle, the report shows (*111*: p. lv) that while the

TABLE 28

Nationalities on the Increase Among Iowa Foreigners

Nationalities among the foreign-born of Iowa having the largest increases between 1905 and 1915, with the increases, and a summary of decreases among nationalities having a decrease. Source of data 111 p. lv.

Nationality	Increase or decrease (—)
Russian	6,071
Greek	4,678
Italian	4,616
Austrian	3,615
Other increasing nationalities	9,727
Total increase	28,707
Nationalities showing decrease	—46,825
Net decrease	—18,128

total number of foreign-born persons in Iowa decreased in the decade 1905-1915, certain nationalities increased by a total of 28,707 persons. The most prominent of these increases are given in Table 28.

This fails to show the true influx of foreigners, since many of those who were in the state in 1905 died or left Iowa before 1915. The most reliable way of getting at the approximate amount of net immigration to Iowa by foreign-born persons is to use the same method as that applied to the general population. The possible errors noted in connection with that method apply with somewhat different force here. Reliable death rates for the foreign-born in Iowa are difficult to estimate. The dominant foreign stocks are German, Scandinavian, and British,—groups with presumably much lower death rates than the more recent immigrants who are more prominent in the registration states. Death rates of the foreign-born are not differentiated in Glover's tables according

TABLE 29

FOREIGN IMMIGRATION TO IOWA

Estimated net migration of white persons born outside the United States into or out of (—) Iowa, by age periods, during the pentads 1900-1905, 1905-1910, and 1910-1915. Sources of data *106*; *110*; *111*; *122*; *125*.

Ages at beginnings of pentads	1900-1915		
	Both sexes	Males	Females
All ages	53,500	35,900	17,600
0	3,400	1,700	1,700
0-4	5,700	2,900	2,800
5-9	3,300	2,000	1,300
10-14	10,900	7,100	3,800
15-19	21,400	14,900	6,500
20-24	10,600	7,900	2,700
25-29	1,400	0	1,400
30-34	—2,800	—1,200	—1,600
35-39	—1,600	—1,300	—300
40-44	3,500	3,000	500
45-49	—2,900	—2,200	—700
50-54	—4,200	—1,300	—2,900
55-59	800	—300	1,100
60-64	1,900	1,000	900
65-69	1,200	1,300	—100
70-74	1,200	600	600
75-79	100	0	100
80-84	200	200	0
85-89	—100	—100	0
90-	100	100	0
Unknown	—600	—400	—200

to urban or rural residence, and Iowa's foreign residents are chiefly rural while those of the registration area are more likely to be urban dwellers. For these reasons it has seemed best to use the same death rates as were used for the entire population. These rates, if correct for the total population, are probably too low for the foreign-born. If they are too high for the general population, as seems probable, it is not unlikely that they are approximately correct for the foreign-born.

As to age grouping, the fact that the number of foreign-born under one year of age is negligible removes any appreciable error from that source. On the question of the accuracy of totals of foreign population there is no independent check available.

The use of this method brings the result shown in Table 29.

Whereas Table 27, shows an exodus from the state totalling 224,900 in fifteen years, Table 29 shows that in the meantime at least 53,500 foreign-born persons have entered the state, of whom 44,400 were over four years of age at the beginnings of the pentads in which they migrated. Now the net number of native-born persons leaving the state at a given age is equal to the net migration of all nativities out of the state at the same age, minus the net foreign migration out of the state at that age. In other words, it is the algebraic difference between the total and the foreign net emigration. Hence it becomes evident that at least 224,900 plus 44,400 or 269,300 native-born persons left the state between 1900 and 1915 in excess of those who entered during the same period.

Migration from Other States

How many natives of other states migrated into Iowa during this period, it is more difficult to estimate. The general trend of migration is indicated by census reports as to state of birth. If the number of persons born in Iowa, but living in other states be subtracted from the number of persons born in other states but living in Iowa, an index of the cumulative loss or gain through migration is obtained. Table 30 shows the index and its derivation. This table indicates that 250,000 native Iowans left the state between 1900 and 1910 in addition to the number needed to offset deaths among Iowans living in other states in 1900. It also indicates that the number of natives of other states in Iowa has remained fairly constant for at least 35 years, so that new migration to the state must have occurred.

TABLE 30

The Balance of Migration in Iowa

Comparison of the number of Iowa-born citizens living in other parts of the United States with the number of persons living in Iowa but born in other parts of the United States. Sources of data *110*: pp. 504, 508; *111*: pp. 453, 459; *116*: pp. xxxvif; *117*: p. xxxiii; *118*: pp. 328 ff; 125: pp. 700-1.

Date	Natives of other states living in Iowa	Natives of Iowa living elsewhere in the U. S.	Balance of migration
1850	20,240	6,358	113,882
1860	376,081	37,535	338,546
1870	562,708	89,001	473,707
1880	625,650	217,389	408,261
1890	577,088	397,985	179,103
1900	600,353	554,340	46,013
1905	547,847	....	....
1910	524,774	801,836	—247,062
1915	542,502	....	....

While the states of birth of the native population born outside of Iowa are given, their age distribution is not. It seems probable that this age distribution is closely similar to that of the foreign-born population. In this case, approximately ten percent of such persons would die during a five year period. In this very rough basis the calculations shown in Table 31 are made. The sources

TABLE 31

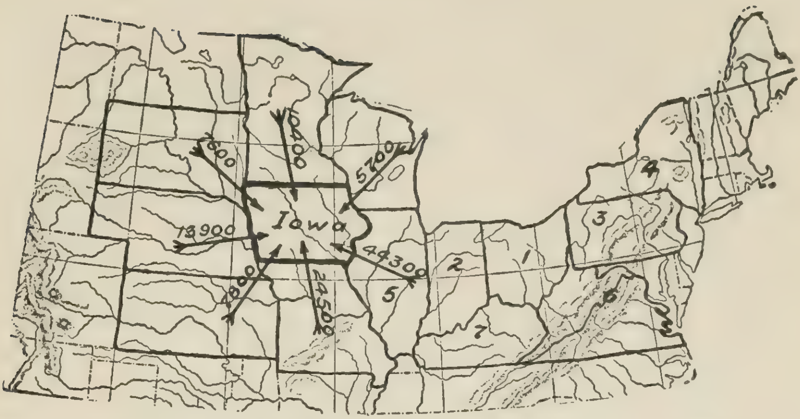
Migration from Other States to Iowa

Rough estimate of net migration to Iowa of natives of other parts of the United States. Sources of data *110*: pp. 504, 508; *111*: pp. liv; *125*: pp. 700-1.

Period	Natives of other parts of the United States resident in Iowa at beginnings of periods	Estimated survivors at ends of periods	Actual residents of Iowa native of other parts of the U. S. at ends of periods	Estimated net migration
1900-1915				109,441
1900-1905	600,353	540,317	547,775	7,458
1905-1910	547,775	492,917	524,774	31,777
1910-1915	534,774	472,296	542.502	70,206

of recent native migration into Iowa, in comparison with early sources, is shown in map form in Chart 10. Estimating migration of native born persons into Iowa on the above basis, indicates according to Table 31, that at least 109,000 such persons entered the state in the period from 1900-1915 in excess of the number of

CHART 10



SOURCES OF RECENT NATIVE MIGRATION TO IOWA.
The seven states contributing the largest numbers of their natives to the Iowa population between 1900 and 1915 are indicated by arrows. For comparison the seven states having the largest numbers of their natives living in Iowa in 1860 are marked with numbers in the order of their rank in this respect.

natives of other states leaving Iowa, and that of these persons, 90 percent came from five adjacent states.

TABLE 32

SOURCES OF RECENT NATIVE MIGRATION TO IOWA

1900-1915

Sources of data same as for Table 31.

State of birth	Net migration to Iowa, 1900-1915
Total of six states	108,500
Illinois	44,300
Missouri	24,500
Nebraska	13,900
Minnesota	10,400
Kansas	7,800
South Dakota	7,600

The large trends of population discussed above are summarized in Table 33. During the fifteen years covered in Table 33, the total net emigration from the state has decreased, immigration of natives of other states and countries into Iowa has increased, and emigration of native Iowans has decreased. The most striking fact is that nearly 400,000 native Iowans moved out of the state

TABLE 33

SUMMARY OF NATIVITIES OF IOWA MIGRANTS

Migrants into and out of (—) Iowa exclusive of children under five years of age at beginnings of each pentad, classified according to general nativity, 1900-1915. Sources of data Tables preceeding.

Periods	Net migration of combined nativities	Net migration of foreign born into Iowa	Net migration of natives of other states into Iowa	Migration out of Iowa of persons born in the United States
1900-1915	—224,900	44,400	109,500	—378,800
1900-1905	—130,050	5,000	7,500	—142,550
1905-1910	—102,900	20,000	31,800	—154,700
1910-1915	8,050	19,400	70,200	—81,550

between 1900 and 1915. If the full facts were obtainable this number would doubtless be larger.

The conclusions in the section on errors in returns of total population (pp. 99 ff.) indicate that the exodus may have been greater in 1910 to 1915 than these estimates show, but there is no question that a decrease in emigration occurred.

The returns of the 1920 census are not yet available in sufficient detail to permit the application of the age distribution method of measuring migration during the decade just past. The totals for Iowa and its leading cities indicate, however, that the gain in population for the state as a whole has been about one-third as large during the past five years as in the preceding pentad, while the

TABLE 34

IOWA POPULATION GAINS AND LOSSES, 1900-1920

(*111* p. 593, and advance bulletins 1920 census)

	Population			
Date	State as a whole	Cities over 25,000 in in 1920	Cities 10,000 to 25,000 in 1920	Other districts
1920	2,403,630	411,521	192,615	1,799,494
1915	2,358,066	362,822	190,195	1,805,049
1910	2,224,771	304,514	171,564	1,748,693
1905	2,210,050	270,377	159,481	1,780,192
1900	2,231,853	230,839	149,407	1,851,607

	Five year gains or losses (—)							
Date	State as a whole		Cities over 25,000 in 1920		Cities 10,000 to 25,000 in 1920		Other districts	
	Number	%	Number	%	Number	%	Number	%
1920	45,564	1.9	48,699	13.4	2,420	1.3	—5,555	—.3
1915	133,295	6.0	54,308	19.2	18,631	10.8	56,356	3.2
1910	14,721	.7	34,137	12.6	12,083	7.6	—31,499	—1.8
1905	—21,803	—1.0	39,538	17.1	10,074	6.7	—71,415	—3.9

districts outside cities over 10,000 in population have again experienced a loss in population. This loss was not so great as that which occurred between 1900 and 1910, but it is sufficient to indicate that a very pronounced emigration from the rural districts is still occurring. These data are presented in Table 34.

Emigration From Iowa and From New England

An outstanding fact about interstate migration as regards Iowa is that, out of 2,218,420 residents of the United States born in Iowa 801,836, or 36.1 percent were living in other states in 1910. (*125*: p. 700). This does not include natives of Iowa living in Canada and in other foreign countries.

The comparison with New England conditions is striking. Iowa had a larger percentage of its natives reported as living in other states than any of the New England states except Vermont, has had at any census since 1850. The comparison is shown in Tables 35 and 36, and Chart 11.

TABLE 35

The Exodus from Iowa and From New England

Percentages of the natives of Iowa living in other states, compared with corresponding percentages for the New England States, for censuses since 1850. Derived from data in *116*: pp. xxxvi, f; *117*: pp. 616-19; *118*: pp. 328 ff.; *125*: p. 700-1.

State	1910	1900	1890	1880	1870	1860	1850
Iowa	36.1	29.6	28.5	22.8	17.2	16.2	11.1
Maine	26.9	27.9	27.5	24.5	21.2	17.1	11.4
New Hampshire	33.8	33.8	34.1	34.6	34.0	34.5	29.5
Vermont	38.6	40.4	40.9	41.5	42.1	42.1	38.4
Massachusetts	16.1	16.3	17.9	19.7	22.1	22.6	22.2
Rhode Island	21.5	22.3	22.7	24.4	26.5	29.1	29.6
Connecticut	21.5	21.6	23.1	26.1	28.2	32.1	34.5

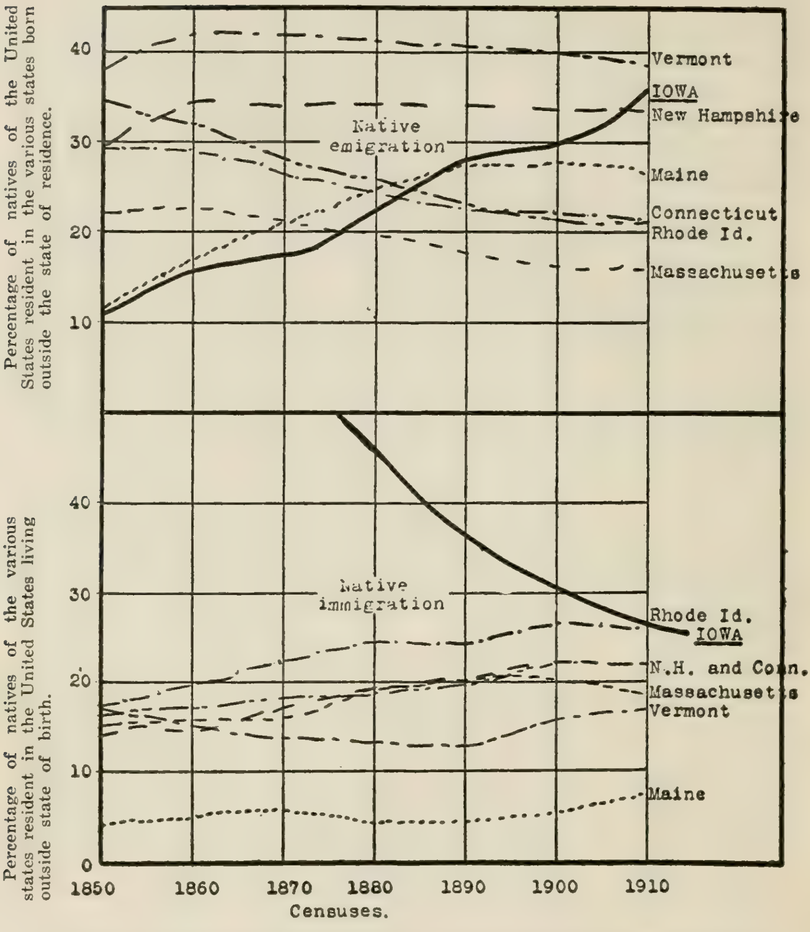
TABLE 36

New Native Blood in Iowa and New England

Percentages of the native white residents of Iowa born in other parts of the United States, compared with corresponding percentages for the New England States, for censuses since 1850. Sources of data same as for Table 35.

State	1910	1900	1890	1880	1870	1860	1850
Iowa	27.0	31.3	36.6	45.9	56.7	66.3	70.5
Maine	8.0	6.2	4.6	4.6	6.1	5.1	4.1
New Hampshire	24.9	24.3	20.7	19.3	16.0	15.7	14.0
Vermont	17.2	16.1	13.2	13.6	13.9	15.2	17.3
Massachusetts	18.9	20.6	20.1	18.7	18.2	17.0	16.2
Rhode Island	26.2	27.0	24.8	24.7	22.5	19.8	17.5
Connecticut	22.3	22.6	19.8	19.2	17.1	14.7	12.0

CHART 11



IOWA AND NEW ENGLAND MIGRATIONS COMPARED.

Percentages of natives of Iowa living elsewhere in the United States compared with similar percentages for the New England states, and percentages of Iowa populations born in other parts of the United States compared with similiar percentages for the New England states, 1850 to 1910. Source, Tables 35 and 36.

18. AGE AND SEX DISTRIBUTION OF MIGRANTS

The age and sex distributions of these human currents are highly significant. Such conclusions as may be drawn on these points for the 15 year period have been compiled in Table 37.

The lack of data as to the sex and age distribution of natives of other states migrating to Iowa leaves this table incomplete. The columns headed ''All Nativities'' cover the net result to the state of the various streams of migration. The columns headed ''Foreign Born'' show fairly accurately the net immigration of foreigners. But the column headed ''Born in U. S.,'' while it gives the approximate net emigration of American born persons out of Iowa, does not give any idea of the total amount of migration, since, as was pointed out above, about 130,000 natives of other states moved into Iowa in this period. In order to give a net emigration of 269,300 Americans from Iowa, it is shown in Table 33 that 378,800 persons must have left the state. The age and sex distribution of only 269,300 of these can be safely estimated and these estimates appear in the central column of Table 37.

The age data are summarized in Chart 12. Instead of consisting primarily of men and women along in years who have built up fortunes in Iowa, two-thirds of the emigrants are young people 15 to 34 years of age. These would seem to be chiefly persons who aim to make their start in life in some other state. A subordinate mode occurs at 40 years of age, and perhaps consists of farmers who have tried farming in Iowa and failed, or decided to go elsewhere for various reasons to farm. The mode between 50 and 60 years, containing about 25,000 persons or about one-tenth of all the emigrants is the group usually thought of as typical of the farmers leaving Iowa—the successful ones who have sold out and gone to California or elsewhere to retire on their earnings. This group, it should be noted in Table 27 was larger in the last two pentads than in 1900-1905, in spite of the decrease in emigration in other groups.

The apparent net ingress to the state at ages over 65 may possibly be an actual immigration of eastern farmers later in life. Another explanation might be that the death rate in the upper ages is lower in Iowa than in the registration area, so that the apparent immigrants may be really additional survivors of Iowans of earlier ages.

TABLE 37

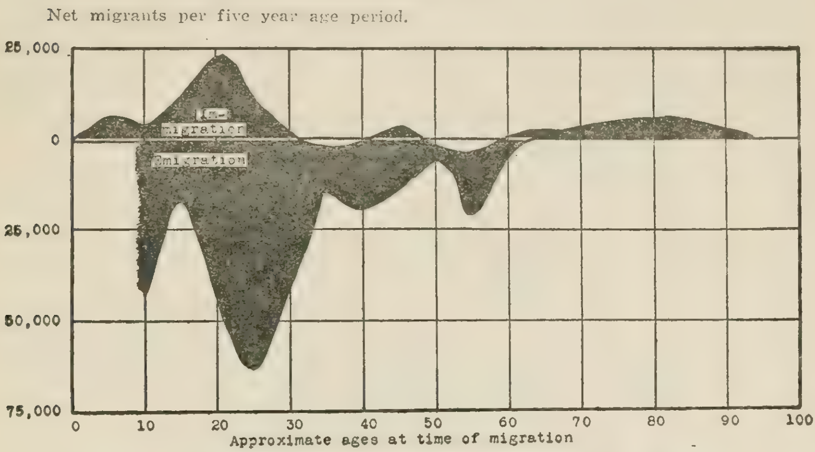
Iowa Migrants by Nativities, Ages and Sexes

Estimated distribution according to age, sex, and general nativities of migrants into and out of (—) Iowa, exclusive of natives of other parts of the United States migrating into Iowa and of compensating emigration from Iowa, 1900-1915. Derived from preceeding tables.

Ages at beginnings of pentads	All nativities			Born in the U. S.			Foreign-born		
	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All ages over 5	—224,900	—107,500	—117,400	—269,300	—138,800	—130,500	44,400	31,300	13,100
5-9	—39,600	—19,200	—20,400	—42,900	—21,200	—21,700	3,300	2,000	1,300
10-14	—8,000	—6,700	—1,300	—18,900	—13,800	—5,100	10,900	7,100	3,800
15-19	—21,500	—11,900	—9,600	—42,900	—26,800	—16,100	21,400	14,900	6,500
20-24	—50,100	—23,600	—26,500	—60,700	—31,500	—29,200	10,600	7,900	2,700
25-29	—40,650	—19,750	—20,900	—42,050	—19,750	—22,300	1,400	0	1,400
30-34	—15,700	—6,900	—8,800	—12,900	—5,700	—7,200	—2,800	—1,200	—1,600
35-39	—19,350	—8,700	—10,650	—17,750	—7,400	—10,350	—1,600	—1,300	—300
40-44	—10,100	700	—10,800	—13,600	—2,300	—11,300	3,500	3,000	500
45-49	—6,500	—3,500	—3,000	—3,600	—1,300	—2,300	—2,900	—2,200	—700
50-54	—19,850	—10,850	—9,000	—15,650	—9,550	—6,100	—4,200	—1,300	—2,900
55-59	—3,550	—2,600	—950	—4,350	—2,300	—2,050	800	—300	1,100
60-64	950	1,050	—100	950	50	—1,000	1,900	1,000	900
65-	13,550	7,350	6,200	10,850	5,250	5,600	2,700	2,100	600
Unknown	—4,500	—2,900	—1,600	—3,900	—2,500	—1,400	—600	—400	—200

Sex contrasts are also worthy of note, though less significant than the age distribution. Among the foreign immigrants to Iowa, males strikingly predominate. This is due almost wholly to a spectacular influx of foreign males in 1905 to 1910 with no corresponding increase in female immigration. In 1910 to 1915 immigration was more evenly distributed as to sex. Among emigrants

CHART 12



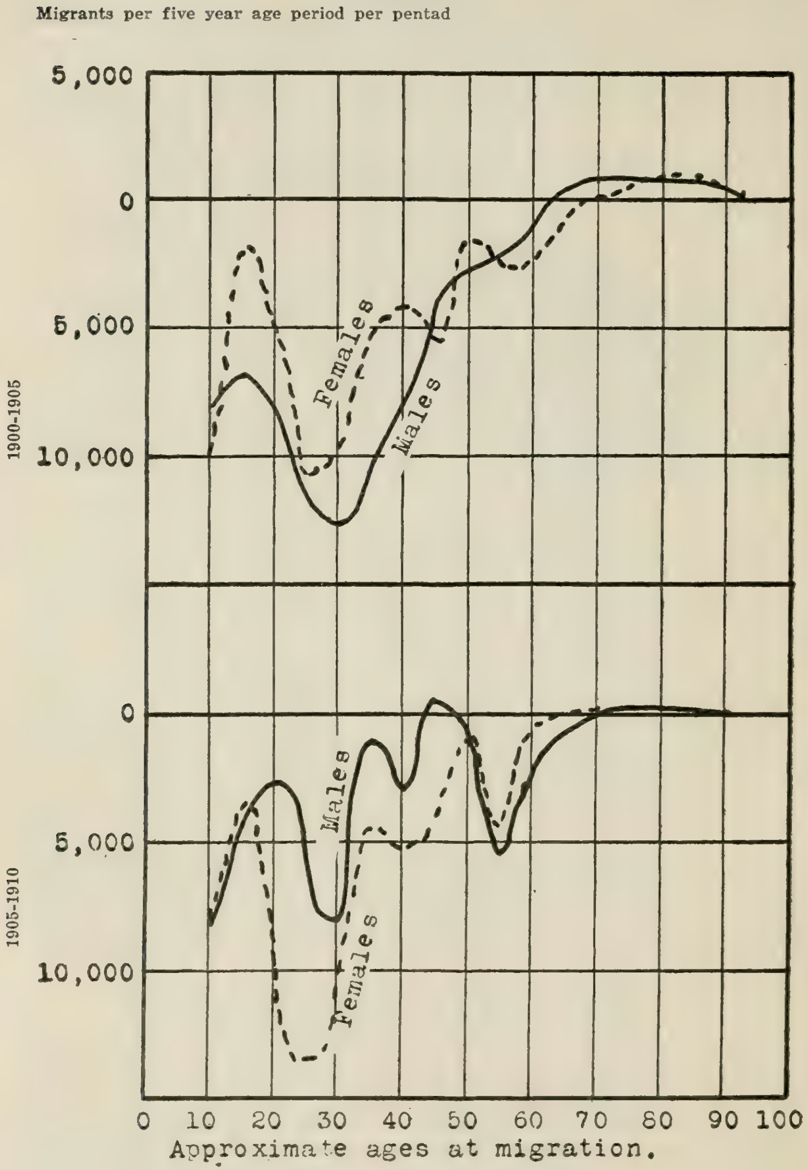
AGE DISTRIBUTION OF IOWA MIGRANTS 1900-1915.
Black areas above the zero line indicate amounts of net foreign-born migration into the state at various ages; black areas below the line indicate net emigration of persons born in the United States from Iowa. Data from Table 37.

from the state, men predominated decidedly in 1900-1905, while women predominated in 1905-1910. Among emigrants born in the United States men predominate between 15 and 25 years of age, while women predominate between 25 and 50 years of age. Chart 13 bears on these points.

19. DESTINATION OF IOWA EMIGRANTS

Another angle of attack upon the problem of emigration from Iowa is the analysis of the data as to natives of Iowa resident in other parts of the United States. In Table 30 it appears that the number of such persons increased from 554,340 in 1900 to 801,836 in 1910, a gain of 247,496. Obviously however, some of the natives of Iowa resident in other states in 1900 must have died in the intervening ten years. Assuming as in the case of migrants to

CHART 13



SEX DISTRIBUTIONS BY AGES OF EMIGRANTS FROM IOWA.
Source of data preceding tables.

Iowa from other states, that the age distribution of these former residents of Iowa is similar to that of the foreign-born in the state, about 20 percent of them would die in 10 years. On this basis, 356,598 natives of Iowa have emigrated to other states in this 10 years, in addition to persons going to Canada and to other foreign countries. The estimate given in Table 30, on the basis of the Iowa population, is 297,250 for the decade 1900-1910. The larger estimate is a much rougher one than the smaller, and it is probable that the true figures was nearer 300,000 than 350,000. However, it is worth while to apply this rough method with a view to getting an idea of where the bulk of the emigrants from Iowa go. The use of this method produces the results shown in Table 38.

A number of important conclusions may be drawn from Table 38. First, it is evident that the interstate migration is not a mere

TABLE 38

DESTINATION OF IOWA EMIGRANTS

Estimated numbers of Iowa-born persons emigrating to the large cities and the small cities and rural districts of other states during the decade 1900-1910. Based on data from *125* pp. 700ff.

Destination	All emigrants to other parts of the United States		Emigrants to cities of over 50,000		Emigrants to districts outside such cities	
	Number	Percent	Number	Percent	Number	Percent
All parts of the U. S.	356,600	100.0	75,000	21.0	281,600	79.0
South Dakota	51,000	14.3	......	....	51,000	14.3
California	46,400	13.0	12,800	3.6	33,600	9.4
Texas	36,400	10.2	1,200	.3	35,200	9.9
Minnesota	33,400	9.4	9,400	2.6	24,000	6.8
Washington	31,800	8.9	13,300	3.7	18,500	5.2
Nebraska	26,000	7.3	5,200	1.5	20,800	5.8
Colorado	24,300	6.8	5,200	1.4	19,100	5.4
Oklahoma	23,600	6.6	2,000	.6	21,600	6.0
North Dakota	23,300	6.5	......	....	23,300	6.5
Other parts	60,400	17.0	25,900	7.3	34,500	9.7

interchange between Iowa and other states. Not only is the number of out-going migrants three times as large as the number of incoming native-born persons, but the five states that furnished 90 percent of the incoming migrants (Illinois, Missouri, Nebraska, Kansas, and South Dakota) did not gain and lose compensatory numbers. Illinois contributed about 24,000 migrants to Iowa, and received 19,500 from Iowa, 8,100 of whom went to cities of over 50,000—chiefly Chicago. Kansas lost about 6,200 of its Iowa-born

citizens during the decade, while about 2,700 natives of Kansas moved to Iowa. The other three states made net gains in the interchange—Missouri about 3,300, Nebraska about 20,000 and South Dakota about 48,200.

The trend to the cities is the next striking fact indicated by Table 38. Over one-fifth of the emigrants from Iowa went to cities over 50,000 in size. This is especially significant since less than four percent of the American-born population of Iowa lives in cities of over 50,000, and since the rural districts and not the cities of Iowa are losing through emigration. This trend to cities has increased markedly since 1900. At that census, only 14.9 percent of Iowa-born population of other states lived in the cities of 50,000. In 1910 the percentage in such cities had risen to 18.8, and the percentage of migrants during the decade going to such cities was 21.0. The percentage going to smaller cities is not ascertainable from the 1910 census. In 1900, of the Iowa-born population living in other states 3.6 percent lived in cities between 25,000 and 50,000. It seems entirely safe to assume, therefore, t hat at least one-fourth of the emigrants from Iowa to other states went into the large cities. In addition to this the trend to Iowa cities from rural districts of Iowa must be considered. This will be discussed in the next section.

Of the approximately 75,000 Iowans who emigrated to large cities in other states between 1900 and 1915, two-thirds went to the following ten cities:

Los Angeles	8,900
Seattle	6,800
Chicago	6,800
Portland (Ore.)	5.800
Minneapolis	5,700
Omaha	5,200
Denver	5,200
Spokane	4,400
St. Paul	3,200
Kansas City (Mo. and Kans.)	5,100
Total, 10 cities	57,100

It is the cities of the North-west that are attracting the young men and women of Iowa. Chart 14 presents the chief trends in map form.

Table 38 covers only the emigrants from Iowa to other states, not to other countries. The absence of complete emigration sta-

CHART 14

CHIEF DESTINATIONS OF IOWA EMIGRANTS, 1900-1910. States receiving over 15,000 Iowa migrants to their rural districts during the decade are indicated by solid arrows; cities receiving over 3,000 ar indicated by dotted arrows. Source of data same as Table 38.

tistics by the United States, and of complete immigration statistics by Canada, make it difficult to estimate the number of Iowans migrating to that country. The number going to other countries is probably negligible. Some idea of the migration to Canada may be gained from the fact that between the years 1897 and 1913 an average of 57,500 persons per year entered Canada from the United States. Iowa's proportionate share would have been about 12,600 for the decade. Presumably she contributed more than this quota.

20. THE CURRENT TO THE CITIES

That the rural districts of Iowa have been losing population steadily since 1900 is admitted even by the 1915 state census. The rural and urban population at five year periods for the past twenty-five years as reported in the census are shown in Table 39.

Six Iowa cities for which populations by ages and sex were given in the 1900 Census, were selected for special study. (*125*: p. xxiv) These cities are Dubuque, Cedar Rapids, Des Moines, Council Bluffs, Davenport, and Sioux City. They were the only cities in Iowa having populations over 25,000 in 1900. In 1915

TABLE 39

RURAL AND URBAN POPULATIONS IN IOWA

Number of persons living in incorporated places and number living outside such places at recent censuses, as reported by the state census. *111* p. xxiv.

Year	Total Population	Urban	Rural
1890	1,911,896	700,162	1,211,734
1895	2,058,069	871,744	1,186,295
1900	2,231,853	973,178	1,258,676
1905	2,210,050	1,067,936	1,142,114
1910	2,224,771	1,118,769	1,106,002
1915	2,358,066	1,277,950	1,080,116

Council Bluffs was no longer one of the six largest cities; Waterloo had taken its place. The cities listed, however, are the only ones for which age data are available for 1900.

Application of the age-distribution method for estimating net migration to these six cities for the three pentads considered above, using the weighted death rates of the cities of the original registration states, produces the results shown in Table 40.

TABLE 40

MIGRATION TO THE SIX LARGEST CITIES OF IOWA

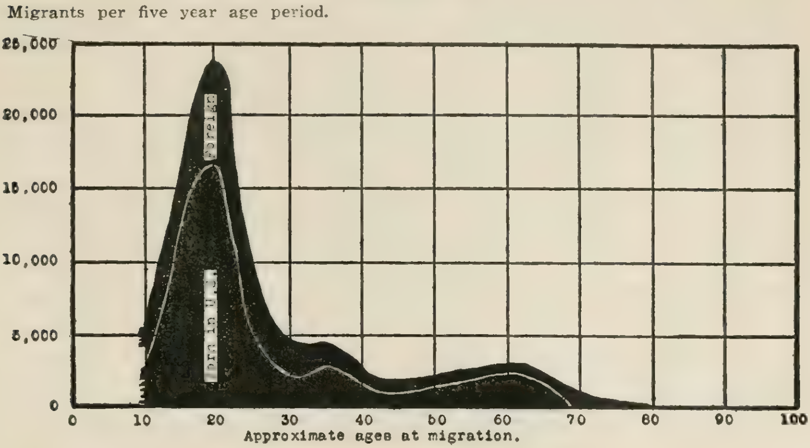
1900-1915, distributed according to nativities, sex and ages. Based on data from *106*; *110*, pp. 2-382; *111* pp. 2-417.

Ages at beginnings of pentads	All nativities			Born in the U. S.			Foreign-born		
	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
Five and over	75,100	40,700	34,400	51,200	25,200	26,000	23,900	15,500	8,400
5-9	4,000	1,700	2,300	3,100	1,300	1,800	900	400	500
10-14	15,300	5,800	9,500	12,500	4,200	8,300	2,800	1,600	1,200
15-19	23,100	11,400	11,700	16,800	7,200	9,600	6,300	4,200	2,100
20-24	9,200	6,500	2,700	5,200	3,600	1,600	4,000	2,900	1,100
25-29	4,600	3,800	800	2,100	1,900	200	2,500	1,900	600
30-34	4,300	3,000	1,300	2,800	1,900	900	1,500	1,100	400
35-44	4,000	2,900	1,100	2,800	2,000	800	1,200	900	300
45-54	4,100	2,100	2,000	3,000	1,400	1,600	1,100	700	400
55-64	6,400	4,200	2,200	4,900	3,200	1,700	1,500	1,000	500
65-	900	—300	1,200	—1,200	—1,100	—100	2,100	800	1,500
Unknown	—800	—400	—400	—800	—400	—400	.....	....	.....

The contrast between Table 40 and the corresponding tables for the state as a whole is striking. While the state sustained a net loss of 269,300 persons born in the United States, these six cities gained 51,200 native-born migrants. The net losses through native migration were therefore sustained by the rural sections, not by the larger cities. Of the 44,400 foreign-born immigrants, entering Iowa in excess of foreign emigrants, 23,900 located in the six cities and only 20,500 located elsewhere in the state. Instead

of tapering off, the migration to the cities was as large in the five years 1910-1915 as in the ten years 1900-1910. While about 40 percent of the emigration from the state occurred at the ages 22.5 to 32.5 years, half of the migration to cities occurred at the ages 15 to 25. The age distribution of these migrants is shown in Chart 15. A comparison of this chart with Chart 12 brings out

CHART 15



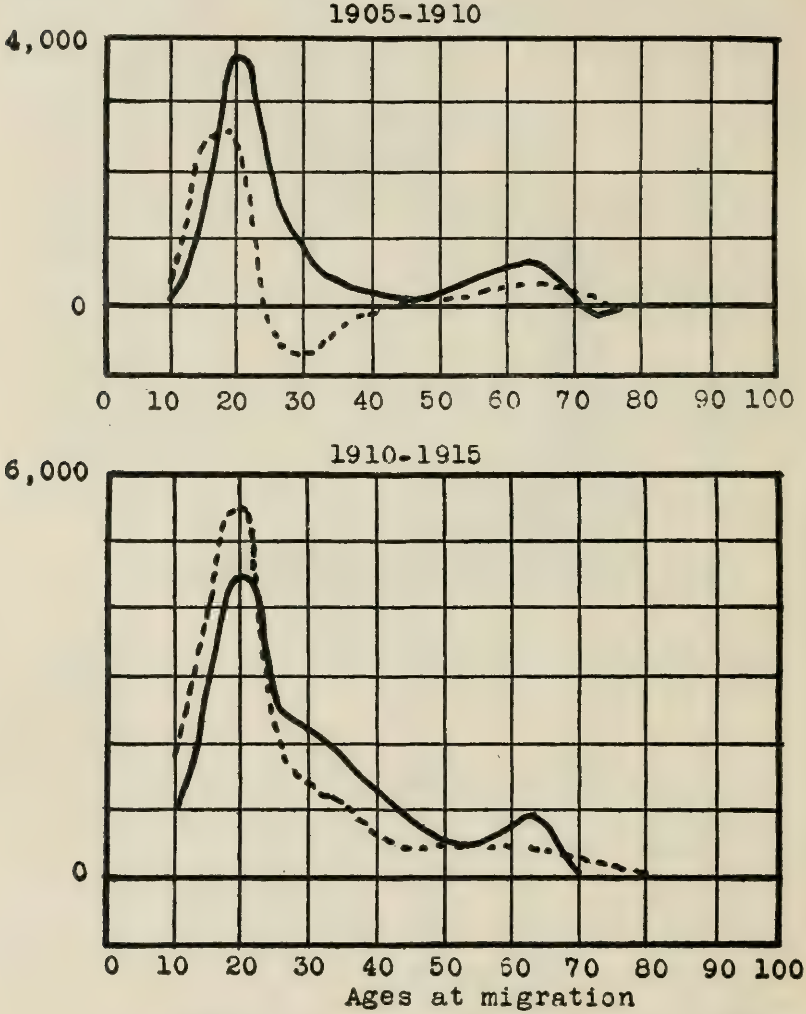
AGE DISTRIBUTION OF MIGRANTS TO IOWA CITIES.
Migrants to six large cities of Iowa from 1900-1915 distributed according to age and general nativity. Source, Table 40.

several striking facts. First of course, the migration is outward in the case of the state, and inward in the case of the cities. Second, Chart 12 suggests that a number of children under 10 years of age probably accompanied their parents out of the state. Chart 15 gives no such suggestions as to the migrants entering cities. Whereas families are leaving the state, single persons are entering the cities. Thirdly, both Chart 12 and Chart 15 show three modes of migration, one in youth, one in middle life, and one in old age. The first two modes are earlier in the city curve than in the state curve. The most frequent age of migration to the city is about 19 years; the most frequent age of leaving the state is about 26. The retired farmer mode is a trifle later in the city curve than in the state curve.

Sex differences are even more striking in city migration than in that from the state. Chart 16 illustrates these differences for the pentads with the smallest and largest migrations. The most strik-

CHART 16

Migrants per five year age period per pentad.



———Males ....Females

SEX DISTRIBUTION OF MIGRANTS TO IOWA CITIES.

Migrants to six large Iowa cities in 1905-1910 and 1910-1915 distributed according to sex and age. Source of data Table 40.

ing contrast is that the girls tend to go to the cities about two years younger than the boys. The migration may be described as primarily a phenomenon of adolescence, since the greatest frequency

occurs in the late teens. This coincides also, of course, with the period at which young people enter industry.

As between the two pentads, the later one exceeded the other especially in the number of females who came to the cities and in the number of older men. There was also a striking increase in the very young groups, suggesting that families may have been more prominent in this later migration.

For comparison with the six cities studied above, migration data for the fourteen other cities in Iowa having a population over 8,000 in 1905 were analized for the decade 1905 to 1910. These data seem to indicate that the smaller city is more likely to be the resort of retired farmers and their wives, of farmer's widows, and of young girls going into industry, while the larger cities attract somewhat more strongly the young men and mature women. These differences are due in part to the fact that the larger cities three-fourths of the immigration between 1905 and 1915 was of foreign-born persons, while in the smaller cities less than half of the immigrants were foreign-born.

21. FECUNDITY AND MIGRATION IN IOWA

The fact which at once strikes the student of statistics of childhood in Iowa is that the number of young children is rapidly decreasing relative to the total population of the state. The number of children under one year of age deported by the census of 1880 was 48,025. In 1910, in spite of the fact that the total population had increased more than a third, the number of children under one year of age was reported as 48,190—a net increase of one-third of one percent, in 30 years.

More accurate as an index of the decrease in the proportion of children in the population is the number under five years of age per 1,000 women of child-bearing age. These ratios are shown for the past eight federal censuses and the latest state census in Table 41, in comparison with similar data for the West North Central States and the United States. This table, the data of which are presented graphically in Chart 17, shows that the number of children in Iowa relative to the number of women of child-bearing age, has fallen to only 40 percent of what it was in 1840. Relative to the fecundity index of the United States as a whole the Iowa index has shrunk from a third larger than the rest of the country to a point definitely lower than other states. The

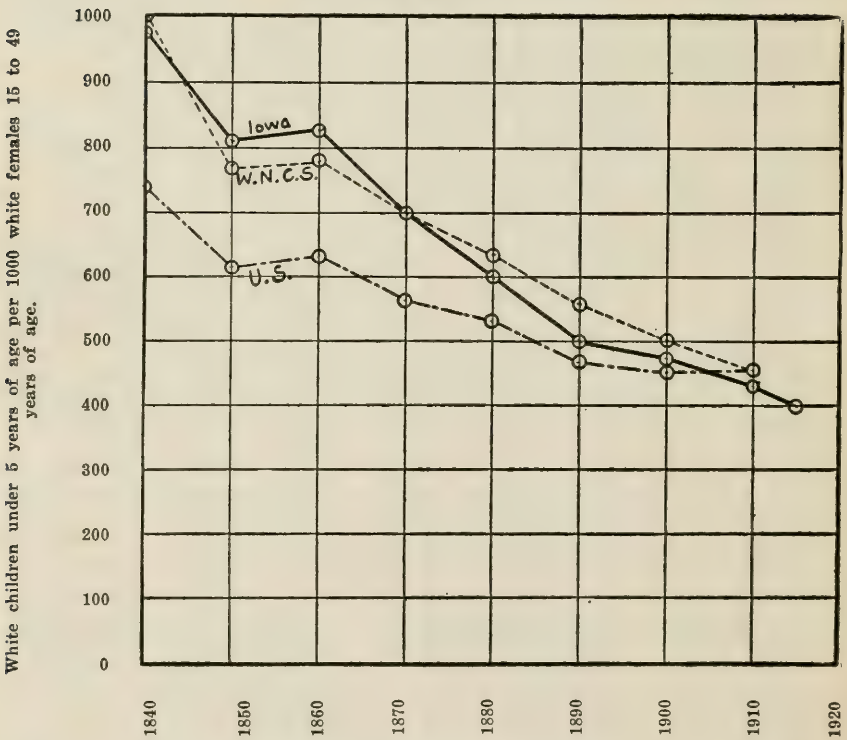
TABLE 41

FECUNDITY INDICES IN IOWA, THE WEST NORTH CENTRAL STATES AND THE UNITED STATES

1840-1915. (*110*: p. lviii; *125*: pp. 303, 374; *129*: p. 18.)

Year	White children under five years of age per 1000 white females 15 to 49 years of age			Iowa index divided by United States index
	Iowa	West North Central States	United States	
1840	973	1003	744	1.31
1850	812	775	613	1.32
1860	822	788	627	1.31
1870	701	706	562	1.25
1880	602	636	537	1.12
1890	504	549	473	1.06
1900	478	505	465	1.03
1910	417	445	441	.96
1915	388			

CHART 17



DECREASE IN THE RELATIVE NUMBER OF CHILDREN IN IOWA

same general condition is evident in comparison with the West North Central group of states, of which Iowa is one. In 1850 and 1860 the censuses showed Iowa as being about five percent above this group of states as a whole in its fecundity index. Since 1860 Iowa has been below the rest of the division. In 1910 its index was about five percent smaller than that of the group as a whole.

The indices shown in Table 41 are crude ratios, uncorrected for differences in urban-rural and nativity distributions. A sounder comparison between Iowa and other parts of the United States may be gained, for the years 1890 and 1900, from Table 42. It

TABLE 42

RURAL-URBAN AND NATIVITY CONTRASTS IN FECUNDITY INDICES

White children under five years of age born of native women, per 1000 native white women 15 to 49 years of age, and white children under five years of age born of foreign-born women per 1000 foreign-born white women 15-49 years of age, in rural and in urban districts, in Iowa, the West-North Central States and the United States, 1890 and 1900. (*129*: pp. 24-27)

Type of territory and year	Iowa		West North Central		United States	
	Native women	Foreign women	Native women	Foreign women	Native women	Foreign women
Cities of 25,000 or over						
1890	337	637	353	631	309	565
1900	309	656	301	653	296	612
Smaller cities and rural territory						
1890	483	936	552	962	522	776
1900	470	1043	506	1085	522	841

will be noted that Iowa has a higher fecundity rate in its large cities than obtained in the large cities of the United States as a whole. This was true both in 1890 and 1900, and it was true of both native and foreign women. In smaller cities and rural districts the Iowa rate among native women was nine percent lower than the corresponding rate for the United States as a whole, but the foreign women in rural Iowa had a higher fecundity than foreign women in rural United States. Iowa therefore had a lower fecundity than the United States only among its native women in rural districts. This group, of course, forms 75 percent of the women of child-bearing age in the state.

It will be noted that the fecundity indices for foreign women were in general about twice as large as those for native women, and that the fecundity indices for foreign women increased be-

tween 1890 and 1900 in every group shown in Table 42, whereas the fecundity indices for native women decreased in every group except one in which there was no change. An investigation of the ratio between the number of white children of foreign or mixed parentage and the number of foreign-born white women indicates that the increase in foreign fecundity between 1890 and 1900 was merely a temporary phenomenon in Iowa, and that the number of white children of foreign parentage and the fecundity of foreign women both decreased continuously and rapidly from 1900 to 1915. In Iowa, therefore, especially in view of the relatively small proportion of foreign-born in the state, the danger that the recent immigrant stock will submerge the older native stock does not seem to be imminent.

The contrast between rural and urban territory shown in Table 42 demands further consideration. In every classification in that table rural fecundity is 35 to 75 percent higher than urban. This contrast is especially important in the present inquiry since the cities of Iowa are gaining through migration while the rural districts are losing. It is desirable to discover, therefore, whether the greater fecundity of the rural districts has persisted since 1900. Data comparable with Table 42 are not available for 1910 or 1915, but it is possible from the state census to calculate fecundity indices for rural and urban territory in Iowa in 1915. The results appear in Table 43. These indices are not comparable with those

TABLE 43

RURAL AND URBAN FECUNDITY IN IOWA IN 1915

(Sources of data *111*: pp. 2-417)

Type of territory	Women 21-44 years of age	Children under five years	Children per 1000 women
State of Iowa	415,984	237,760	571
Cities over 25,000	82,295	33,409	405
Cities 8,000 to 25,000	35,785	14,718	412
Rural areas	297,904	189,633	636

in previous tables since the ages of the women as given by the state census are from 21 to 44 instead of 15 to 49. Rural territory in Iowa in 1915 had a fecundity index 55 percent greater than urban territory. Small cities had a fecundity somewhat greater than large cities. An important incidental conclusion from Table 43 is that approximately 80 percent of Iowa children live in rural dis-

tricts or places under 8,000 population. The child welfare problem of Iowa is thus primarily a rural problem.

While it is beyond the scope of the present study to inquire into the causes for differential fecundity it may be worth while to present data bearing upon the question whether the decrease in fecundity and the differences between rural and urban territory may be due to changes in the age at marriage. This is done, for recent chronological changes, in Table 44. It will be noted that the percentage of women 15 to 44 years of age who are married has tended to increase slightly since 1890. The number of early marriages was higher in 1900 and 1910 than it was in 1890, while

TABLE 44

PERCENTAGES OF IOWA WOMEN OF VARIOUS AGES MARRIED 1890-1915
(Sources of data: *111*: p. 491; *121*: III p. 143; *123*: p. 272; *125*: p. 554.)

Ages	Percent married			
	1890	1900	1910	1915
15-44	56.5	56.6	56.7	58.0
15-19	6.7	8.0	7.8	
20-24	45.0	44.3	45.2	
25-34	79.7	76.1	75.5	
35-44	87.8	85.2	83.4	

the percentage married at ages over 25 decreased markedly in the later decades. The data of Table 44 definitely disprove the theory that the decrease in the fecundity of Iowa women is due to increasing postponement of marriage.

Urban women tend to marry later and to stay unmarried to a greater extent than do rural women. In 1910 the percentage of women 15-44 years of age in Iowa cities who were married was 52.7 as compared with 59.0 in the rural districts of Iowa (*125*: p. 604). This difference is too small to account for the greater fecundity of the rural districts. The tendency of foreign-born women to marry early is very marked. Among Iowa white women 15-44 years of age 77.9 percent of the foreign-born were married, as compared with 52.5 percent of the native-born of foreign parents and 55.9 of the native of native parents.

22. OTHER CHARACTERISTICS OF IOWA SETTLERS

Judged by the data used in the correlation studies of the characteristics of migrants, the early population of Iowa approximated fairly closely to the pioneer type. In the percentage of tall re-

cruits in the Civil War the state fell below what might have been expected, but in the proportion of big-chested men among the tall recruits its record was higher than might have been expected. Iowa furnished slightly more recruits than other states of similar density of population, and had a lower divorce rate than similar states. It had a somewhat larger number of journalists and of clergymen, and a somewhat smaller number of lawyers than comparable states. It produced about three-fourths as large a quota of men for Who's Who as the average of all the states, and had about half as large a proportion of authors, lecturers, librarians and painters as the average of all the states.

The sources from which Iowa was settled in the early years are shown in Table 45.

TABLE 45

EARLY SOURCES OF IOWA POPULATION

Birth-places of residents of Iowa in 1850 and 1860, with percentage distributions. Sources of data *116* pp. xxxvi, f.; *117* p. 156.

Places of birth	1850		1860	
	Number	Percent	Number	Percent
All places	192,214		674,913	
Iowa	50,380		191,148	
Other places than Iowa	141,834	100.0	483,765	100.0
Ohio	30,713	21.6	99,240	20.5
Indiana	19,925	14.1	57,555	11.9
Pennsylvania	14,744	10.4	52,156	10.8
New York	8,134	5.7	46,053	9.5
Illinois	7,247	5.1	26,696	5.5
Virginia	7,861	5.5	17,944	3.7
Kentucky	8,994	6.3	13,204	2.7
Other parts of the United States	22,622	16.0	64,836	13.4
Germany	7,152	5.0	38,555	8.0
Ireland	4,885	3.5	28,072	5.8
England	3,785	2.7	11,522	2.4
Other Foreign countries	5,410	3.8	27,932	5.8
Unknown	362	.3		

Of the original settlers of Iowa, as set forth in Table 45, more than half came from the four states of Ohio, Indiana, Pennsylvania and New York. Less than 20 percent came from places not specifically listed in that table. More than 40 percent of the settlers came from Kentucky, Illinois, Indiana and Ohio—states which themselves were frontier territory in the early part of the century. Even the migrants from seacoast states must have descended from stock which not more than a generation or two be-

for settled frontier territory. The pioneers of Iowa were therefore for the most part sons and daughters of pioneers.

The characteristics of the Iowa settlers as reported by the observers quoted are very similar to the characteristics of the settlers elsewhere on the frontier. Perhaps the most striking difference between the reports of Iowa pioneers and of those elsewhere is the frequency with which drinking, carousal and lawlessness are mentioned (*5*; *10*; *27 30*; *32*; *43*; *55*; *69*) as occurring in early Iowa days. Lack of refinement (*42*; *43*; *52*) is also noted rather more frequently than for other pioneers. On the other hand, Lieutenant Lea gives a directly contrary impression (*40.1*: pp. 14-15). The Iowa settlers were noted especially for hospitality, kindness, love of education, and tenacity in the face of discouragements (*4*; *11*; *27*; *42*; *44*; *52*; *54*; *62*). The settlement of Iowa was notable for the number of communistic and coöperative experiments attempted in its early days. The Amana Community (*57*), Icaria (*9*), and settlements by Trappists (*45*), Hollanders (*12*), Quakers (*39*), and Mormons (*6*) may be cited as examples of group colonization. In general the Iowa settlers were characterized by the same energy, vigor, intensity, disregard for inhibitions and capacity for coöperation which were outstanding characteristics of the American pioneers in general.

23. SELECTIVE CHARACTER OF EMIGRATION FROM IOWA

The fact that emigration from Iowa has included a disproportionate number of the potentially distinguished persons of the state is indicated by the fact that whereas 582 persons listed in Who's Who were born in Iowa, only 289 persons listed in that volume live in Iowa.

Similar conclusions are indicated by Cattell's data on American Men of Science:

> The rural New England States, Maine, New Hampshire and Vermont have lost 48 of the 62 scientific men whom they have produced. This is a loss which they can ill afford; it signified a distinct decadence. . . . The condtions in some of the North Central states are also ominous, though more likely to improve. Thus Ohio has lost 41 of its scientific men, more than half of those whom it has produced; Indiana has also lost more than half, and Iowa just half. (*104*).

24. SUMMARY OF CONCLUSIONS FROM CHAPTER IV

1. During the years 1900-1915 Iowa sustained a net emigration

of over 378,800 persons. This emigration was decidedly smaller in 1910-1915 than in the preceding 10 years, but the 1920 census indicates that emigration is again on the increase.

2. Over one-third of the persons born in Iowa are living in other parts of the United States, besides Iowans who have gone to Canada.

3. In its interstate migration Iowa has reached a condition comparable with that of the New England States.

4. Two-thirds of the emigrants from Iowa are young people 15-34 years of age.

5. Over one-fifth of the emigrants from Iowa went to cities of over 50,000 population. The movement of Iowa population is to the west, north-west, and south-west.

6. Rural Iowa has been losing population steadily since 1900.

7. Six large Iowa cities received a net native immigration of 51,200 in the years 1900-1915. This migration was larger in 1910-1915 than in previous pentads. Half of the migration to these cities occurred at the ages 15-25. Girls tend to go to cities at ages about two years younger than boys.

8. The number of children in Iowa per 1000 women of child-bearing age has dropped to 40 percent of what it was in 1840, and has been decreasing faster than corresponding indices for other parts of the United States. The change is not due to changes in the age at marriage.

9. The fecundity in the cities is about two-thirds as high as in rural districts of Iowa. The foreign-born are much more fecund than the native-born. These contrasts are partly but not chiefly explicable as due to differences in ages at marriage.

10. Iowa settlers were fairly typical pioneers, with the desirable qualities of the pioneer stock.

11. Emigration from Iowa includes a disproportionate percentage of the potentially distinguished persons born in the state.

V. CONCLUSIONS AND RECOMMENDATIONS

Interstate migration in the United States has not ceased with the disappearance of the frontier; it is going on at as rapid a rate as ever. Analysis of census data by the age-distribution method indicates that between 1900 and 1910 over 3,000,000 persons migrated from the rural districts in the United States to other countries, to western rural districts, and especially to cities, of the west and middle west. The West North Central States were among the heaviest losers through this migration. Returns for 1920 indicate that the movement has not slackened. These migrants are predominantly from the ages preceding marriage; most of them are potential parents.

Migration is a selective process which tends to pick out the energetic and able individuals and to leave behind the feebly motivated and inferior. As distinguished from older migration to the frontier, migration to cities apparently selects especially those potentially distinguished in intellectual pursuits. In the frontier days the pioneers reproduced much more rapidly than the less aggressive persons left behind; hence early migration was eugenic in its effects. Recent native migrants, with their cityward trend, tend to leave fewer children than the individuals left behind in the rural districts. Hence modern migration tends to be dysgenic an its effects.

Rural Iowa has sustained the emigration of over one-third of the individuals born in the state. Its condition in this respect now parallels that of the New England States whose rural districts have undergone very serious degeneration because of selective emigration. Over half of the individuals of distinction born in Iowa have moved elsewhere, in excess of compensating migration to the state.

Recommendations

The above conclusions indicate the need for wise action if conditions disastrous to the future children of Iowa are to be avoided. It is folly to assume that remedial social work for the defective, dependent and criminal is an adequate program when funda-

mental facts in the dynamics of population indicate the danger of a deterioration in racial stock such as will greatly increase the amount of defectiveness, dependency and delinquency, and at the same time decrease radically the number of aggressive social leaders in rural communities.

Two lines of action are indicated. The first is to seek to decrease the emigration by measures calculated to make rural Iowa attractive to the type of parents which it is desired to retain. Under this head would come measures counteracting the growth of farm tenancy, promoting the improvement of the quality of rural schools, the betterment of rural health conditions, and the increased introduction of modern conveniences and of cultural opportunities into rural districts (*140*; *152*). Movements of this sort are under way. Whether they will be able to stem the tide must be determined by impartial observation. It is open to serious question, however, whether society would gain by the retention in the rural districts of the individuals fitted for marked success in urban occupations.

A second line of action is the taking of measures calculated to counteract the dysgenic influence of emigration by a more rapid multiplication of desirable types of parents and less rapid multiplication of the undesirable. Personally the author believes that this is the more hopeful course.

Among the specific lines of inquiry clearly called for are the following:

1. Analysis of the 1920 census returns with a view to discovering in more detail the migratory tendencies of the past decade.

2. Intensive surveys of typical rural communities in Iowa with the special object of determining the character of recent migrants as compared with residuals and immigrants, and with a view to studying the nature and action of available counteractive agencies and movements.

3. The development of objective scientific methods for measuring the normal energy levels of different individuals. Such tests should be as technically sound as the best intelligence tests.

4. A study of the birth rates or fecundity indices of the various counties or smaller units of Iowa with a view to determining what are the conditioning factors of fecundity, and what types are reproducing most rapidly.

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